AD NUMBER

ADB006756

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies only; Proprietary Information; 01 OCT 1975. Other requests shall be referred to Army Command and General Staff College, Fort Leavenworth, KS.

AUTHORITY

ODDR&E ltr 20 Jan 1976

8/5.52-4358



# The Evolution of the Advanced Attack Helicopter

Dante A. Camia, MAJ, USA
U.S. Army Command and General Staff College
Fort Leavenworth, Kansas 66027



Final report 6 June 1975





A thesis presented to the faculty of the U.S. Army Command and General Staff College, Fort Leavenworth, Kansas 66027

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|---|---|---|
| 1 REPORT NUMBER | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle)<br>The Evolution of the Advanced Attack Helicopter | | 5. TYPE OF REPORT & PERIOD COVERED<br>Final report 6 Jun 75<br>6. PERFORMING ORG. REPORT NUMBER |
| 7. AUTHOR(s)<br>Camia, Dante A., MAJ, USA | | 8. CONTRACT OR GRANT NUMBER(s) |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>Student at the U.S. Army Command and General Staff College, Fort Leavenworth, Kansas 66027 | | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS |
| 11. CONTROLLING OFFICE NAME AND ADDRESS<br>US Army Command and General Staff College<br>ATTN: ATSW-DD<br>Fort Leavenworth, Kansas 66027 | | 12. REPORT DATE<br>6 Jun 75<br>13. NUMBER OF PAGES<br>276 |
| 14 MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) | | 15. SECURITY CLASS. (of this report)<br>Unclassified<br>15a. DECLASSIFICATION/DOWNGRADING SCHEDULE |

AD-B006752

16. DISTRIBUTION STATEMENT (of this Report) 1 OCT 1975

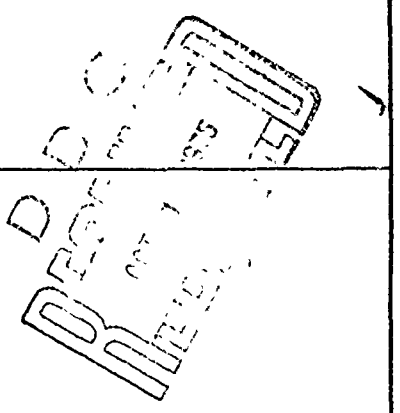
Distribution limited to U.S. Government agencies only: Proprietary Information. Other requests for this document must be referred to U.S. Army Command and General Staff College, Fort Leavenworth, Kansas 66027.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Master of Military Art and Science (MMAS) Thesis prepared at CGSC in partial fulfillment of the Masters Program requirements, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas 66027

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)



20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

See reverse.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

The United States Army is committed to the development of an advanced attack helicopter (AAH). The problem associated with this research endeavor encompasses tracing the introduction, evolution, and development of the AAH. The record of the past and present was examined to increase understanding of what transpired, to resurrect facts about it, and finally to draw conclusions.

The study resulted in the following conclusions:

1. Aviation as an adjunct of the United States military establishment can be traced to the Balloon Corps of the Army of the Potomac, 1861. Thereafter, six distinct reorganizations and redesignations have occurred culminating in the United States Army and its organic aviation elements.

2. The historical process of introduction, evolution and development of the AAH occurred in three separate, identifiable phases. The latter phase is incomplete in that the end product, the AAH, has not yet been produced.

3. At least twice, in two distinct phases of historical evolution, the United States Army or military equivalent of the time, rejected either helicopters or the Advanced Aerial Fire Support System (AAFSS) because of technological sophistication.

4. The result in both cases has been a quantifiable delay in the process of achieving the AAH as an end product. In the first instance, the cancellation of the deBothezat contract, a delay of twenty years resulted, 1922-1942. In the second instance, the cancellation of the AAFSS, a delay of approximately ten years resulted.

5. The RDT&E process contains a degree of technical risk which has been proven to be a significant factor in the helicopter weapon system development process. The technical risk associated with development of military hardware is directly related to the degree which the RDT&E process strains the current state of the art.

6. The United States Army or its military equivalent of the time has been associated with the integration of helicopters and their application in military roles for fifty-seven years. Thirty-three years have elapsed since the introduction of the first practical helicopter. Thirty-three years have elapsed since helicopter armament experiments commenced.

7. The U.S. Army has made significant progress in helicopter armament subsystems during the last twenty years. During this period, one helicopter designed specifically as an aerial weapons platform, i.e., to shoot, has been introduced in the U.S. Army. This occurred during the last half of this twenty year period. To date a totally integrated aerial fire support system employing a helicopter has not been developed.

8. With the introduction of the AAH in the early 1980's, the process of evolution of a helicopter aerial weapons system will mark four decades of gradual refinement. It will follow, by approximately six years, a Soviet introduction of a comparable advanced attack helicopter.

# THE EVOLUTION OF THE ADVANCED ATTACK HELICOPTER

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements of the degree

MASTER OF MILITARY ART AND SCIENCE

DANTE A. CAMIA, MAJ, USA
B.A., Boston College, 1964

Fort Leavenworth, Kansas
1975

PHOTOGRAPHS OMITTED.

WITH ORIGINAL COPY ONLY.

ABSTRACT

The Evolution of the Advanced Attack Helicopter

by

Dante A. Camia

The United States Army is committed to the development of an advanced attack helicopter (AAH). The problem associated with this research endeavor encompasses tracing the introduction, evolution, and development of the AAH. The record of the past and present was examined to increase understanding of what transpired, to resurrect facts about it, and finally to draw conclusions.

Extensive research was conducted in the facilities of the U.S. Army Command and General Staff College Library. Numerous letters requesting assistance in specific areas were dispatched. Addressees included, but were not limited to, COL Jay D. Vanderpool, USA, Ret.; GEN Hamilton H. Howze, USA, Ret.; LTG Harry W.O. Kinnard, USA, Ret.; and BG Samuel G. Cockerham, USA, AAH Project Manager. Other addressees included two military museum curators, four aircraft manufacturers, five professional societies, and twenty four editors, military information officers and military agencies.

In detailing and documenting the process of the introduction, evolution and development of the AAH, the author collected, catalogued, and included one hundred and three photographs. Included are seventeen photographs of individuals and groups who were principal agents in the

historical process. The remainder of the photographs details three elements: first, the developing helicopter; second, the developing helicopter armament subsystems; and, third, the integration and exploitation of technology previously associated with the Advanced Aerial Fire Support System and currently being applied to the AAH.

The study resulted in the assemblage of extensive information in addition to that which is contained specifically in the review of literature portion. This information is contained within the Appendixes and Bibliography. Of particular note for interested readers is the significantly complete chronology.

During the review of literature, the author identified and confronted two distinct challenges. First, to establish the specific organizational framework within which military aviation developed. The study determined that these included:

1861 - Balloon Corps, Army of the Potomac
1862 - Balloon Corps of the Signal Corps
1907 - Aeronautical Division of the Signal Corps
1914 - Aviation Section of the Signal Corps
1918 - Air Service
1941 - Army Air Forces
1947 - United States Army

With the organization established into which the AAH would ultimately be introduced, the second challenge was to trace the following:

First: the introduction of the helicopter into the U.S. Army;

Second: the maturation of the helicopter initially as an innovative mode of battlefield transportation and, subsequently, as a mobile, aerial weapons platform;

Third: the evolution of the first, crudely armed helicopters into sophisticated advanced attack helicopters.

Three distinct phases in the process of developing armed helicopters became evident. The first phase, 1942-1955, consisted of occasional interest in arming helicopters characterized by relatively unsophisticated lash-ups of a weapon to a helicopter. Phase two, 1956-1965, was characterized by significant progress in developing armed helicopters. Initially, it was characterized by enthusiastic experiments with fabricated subsystems by such notables as COL Jay D. Vanderpool. In the latter stage of this phase, a marked advancement occurred; specifically, the introduction of the Cobra, the first helicopter designed specifically to shoot. Phase three, 1965 to the present, began with the award to Lockheed-California of the Advanced Aerial Fire Support System (AAFSS). This phase, largely incomplete, witnessed the cancellation of the AAFSS program on 9 August 1972 and resultant delay in introduction of the proposed AAH.

The study resulted in the following conclusions:

1. Aviation as an adjunct of the United States military establishment can be traced to the Balloon Corps of the Army of the Potomac, 1861. Thereafter, six distinct reorganizations and redesignations have occurred culminating in the United States Army and its organic aviation elements.

2. The historical process of introduction, evolution and development of the AAH occurred in three separate, identifiable phases. The latter phase is incomplete in that the end product, the AAH, has not yet been produced.

3. At least twice, in two distinct phases of historical evolution, the United States Army or military equivalent of the time,

rejected either helicopters or the Advanced Aerial Fire Support System (AAFSS) because of technological sophistication.

4. The result in both cases has been a quantifiable delay in the process of achieving the AAH as an end product. In the first instance, the cancellation of the deBothezat contract, a delay of twenty years resulted, 1922-1942. In the second instance, the cancellation of the AAFSS, a delay of approximately ten years resulted.

5. The RDT&E process contains a degree of technical risk which has been proven to be a significant factor in the helicopter weapon system development process. The technical risk associated with development of military hardware is directly related to the degree which the RDT&E process strains the current state of the art.

6. The United States Army or its military equivalent of the time has been associated with the integration of helicopters and their application in military roles for fifty-seven years. Thirty-three years have elapsed since the introduction of the first practical helicopter. Thirty-three years have elapsed since helicopter armament experiments commenced.

7. The U.S. Army has made significant progress in helicopter armament subsystems during the last twenty years. During this period, one helicopter designed specifically as an aerial weapons platform, i.e., to shoot, has been introduced in the U.S. Army. This occurred during the last half of this twenty year period. To date a totally integrated aerial fire support system employing a helicopter has not been developed.

8. With the introduction of the AAH in the early 1980's, the process of evolution of a helicopter aerial weapons system will mark four decades of gradual refinement. It will follow, by approximately six years, a Soviet introduction of a comparable advanced attack helicopter.

## DEDICATION

This study is humbly dedicated to the memory of Captain Franklin S. Bradley, Jr., United States Army. Captain Bradley, an aviator, was killed in action in the Mekong Delta in the Republic of Vietnam in 1968.

ACKNOWLEDGEMENTS

Valuable assistance was provided by the following:

Jay D. Vanderpool, COL, USA, Ret., Photographs and personal papers.

Hamilton H. Howze, GEN, USA, Ret., Photographs and documentation.

Harry W. O. Kinnard, LTG, USA, Ret., Documentation.

C. D. Cantt, MAJ, USA, PAO, HQS, USA Armor Center and Fort Knox, Photographs and documentation.

Cecil A. Green, CPT, USA, IO, HQ, MASSTER, Documentation.

Clayton R. Barrow, Jr., Editor, US Naval Institute Proceedings.

William R. Ponder, COL, Deputy for Developments USAAVNS, Photographs and documentation.

Roy D. Wells, LTC, IO, HQS III Corps and Fort Hood, Coordination and assistance.

Stephen Podlusky, Museum Curator, US Army Communications Electronics Museum, Photographs and documentation.

Arthur H. Kesten, Editor, Army Aviation, Donation of six volumes of Army Aviation through this author to USA Command and General Staff College Library.

Harry M. Lounsberry, Executive Director, American Helicopter Society, Extensive documentation.

William A. Howell, Curator, USAAVNS Museum.

Richard K. Tierney, Editor, US Army Aviation Digest, Extensive documentation, photographs, encouragement.

Joseph W. Penton, Jr., PIO, HQ USA Materiel Command, Documentation and photographs.

William E. Crouch, Jr., COL, USA, Division Chief, Aviation Systems Division, Weapons System Directorate, Office, Chief of Research, Development and Acquisition, DA.

Donald P. Wray, LTC, USA, Attack Aircraft, Aviation Systems Division, Weapons System Directorate, Office, Chief of Research, Development and Acquisition, DA.

Robert Hurley, MAJ, USA, Air Cavalry and Attack Helicopter Branch, Command and Staff Department, USAARMS, Photographs and documentation.

Barbara McGarvey, Office of the Chief of Information, DA, Photographs and documentation.

Bettie Spiewak, Editorial Assistant, Military Review.

My sincere and deep personal thanks to the members of the Thesis Committee for their patience and astute guidance.

Lieutenant Colonel Wallace P. Franz, Consulting Faculty
Lieutenant Colonel Charles A. Klopp, Graduate Research Faculty
Major Larry B. Fulton, Graduate Research Faculty

Finally, but most importantly, my gratitude to my [redacted] Nancy and my daughters, [redacted] for their sacrifices and understanding.

TABLE OF CONTENTS

LIST OF PLATES

## LIST OF GENERAL ARRANGEMENT DRAWINGS

## LIST OF AIRCRAFT SPECIFICATION SUMMARIES

# CHAPTER I

# THE PROBLEM

## INTRODUCTION

The U.S. Army is committed to the development of an advanced attack helicopter to provide an attack helicopter antitank weapons system. Secretary of Defense James R. Schlesinger articulated evidence of his department's position on 4 March 1974, when he said to the U.S. Congress:

> Our experience in Vietnam confirmed our judgment on the usefulness of TOW-armed attack helicopters in the anti-armor role, particularly with respect to Europe where the Warsaw Pact enjoys a substantial superiority over NATO in numbers of tanks. Accordingly, we intend to press forward with our TOW-armed helicopter programs during the coming fiscal year.[1]

In Vietnam, for the first time in aviation history, the U.S. Army employed an attack helicopter antitank weapons system against an armored enemy force. The deployed TOW system accounted for 24 tanks and armored vehicles.[2] A further determinant of the applicability of the helicopter antitank weapons system may be seen in the 1973

---

[1] James R. Schlesinger, Report of the Secretary of Defense, James R. Schlesinger, to the Congress on the FY 1975 Defense Budget and FY 1975-1979 Defense Program (Washington: Government Printing Office, 1974), p. 108.

[2] S. L. Christine (CPT, USA), "First Combat Aerial TOW Team: Helicopter vs Armor," Aviation Digest, XX, No. 2 (February 1974), 2-5.

Middle East War. It "reaffirmed our earlier conclusion that modern antitank weapons fired from the air as well as the ground can provide an effective counter to the medium tank."[3]

Despite Secretary Schlesinger's declaration of the usefulness of the TOW-armed attack helicopter and his dedication to its incorporation within the U.S. Army, there is an audible voice of opposition regarding this weapons system. Kenneth S. Brower, a naval architect and systems engineer with the George Sharp Company of New York City, noted:

> The Arabs lost four times as many tanks as the USMC owns and committed over six armored divisions (plus many brigades) to combat. Most of the Egyptian and Syrian tanks destroyed were in fact demolished by Israeli tanks. This tends to corroborate the old adage "the best antitank weapon is another tank."[4]

The overall impact and significance of the experience and demonstrated potential of attack helicopters in the antitank role remain to be completely evaluated. However, as a possible innovation on the battlefield, the following statement is revealing:

> (W)hen a time of fundamental change comes in the art of war, a great prize goes to the military institution with the perception to see that a time of great change has come, with the wisdom to see its outlines, with the creativity to exploit technology and human inventiveness to meet the new conditions, and with the leadership--and good luck--to bring about constructive change.[5]

---

[3]Schlesinger, p. 101.

[4]Kenneth S. Brower, "The Yom Kippur War," Military Review, LIV, No. 3 (March 1974), 33.

[5]Department of the Army, U.S. Army Command and General Staff College, Profession of Arms, Course 9000 (SY 1974-75), p. AS-6-1-11, quoting MG John H. Cushman.

Literature records the observations of numerous authors on the subject of the development and exploitation of new weapons systems. S. L. A. Marshall, for example, commented:

> (I)t is unfortunately the case that the masses of men are not capable of taking other than a superficial judgement on the effect of new weapons. History records, moreover, that their military leaders do not always see and think clearly in such matters. As great a soldier as U. S. Grant was slow to understand the revolutionizing effect of the rifle bullet upon tactics. For more than a generation following the Civil War, our naval experts could foresee development of the armored vessel only in the form of a ram. The failure of higher commanders in World War I to understand the potential of armored power and to make proper tactical application of it is an example of almost incredible blundering.[6]

Lieutenant Colonel James M. Galvin wrote:

> Throughout history, as each new technological advance was made, men sought to convert it into greater mobility and striking power for their armed forces.[7]

Brigadier C. N. Barclay noted: "History records that new weapons almost invariably produce an antidote which nullifies or reduces their effectiveness."[8] A few years earlier he had appraised the impact of the helicopter thus:

> In the field of military equipment for conventional land warfare, the helicopter stands out as the predominant innovation since 1945. Used in quantities, it provides a means of reinforcing and supplying isolated troops quickly, evacuating casualties, deploying a substantial body of troops quickly without giving the enemy prior warning, and providing heavy and accurate fire in close support of combat troops on the ground.[9]

---

[6] S. L. A. Marshall, Men Against Fire (New York: William Morrow and Co., 1947), p. 19.

[7] James M. Galvin (LTC, USA), Air Assault: The Development of Air Mobile Warfare (New York: Hawthorn Books, 1969), p. vii.

[8] C. N. Barclay (Brigadier, British Army (Ret.)), "Lessons from the October War," Army, XXIV, No. 3 (March 1974), 29.

[9] C. N. Barclay (Brigadier, British Army (Ret.)), "Asian Combat Lessons, Do They Apply to Europe?," Military Review, L, No. 3 (March 1970), 19.

Major Theodore Wyckoff, almost two decades earlier, considered the dimensions of ground warfare. He wrote:

> There are 3 dimensions to ground warfare, but we are getting full use from only 2 of them. The 3rd dimension, the air--the vertical element--is not being used by soldiers to the fullest extent possible.[10]

Colonel William Bunker, an early advocate of organic employment of aviation within the U.S. Army, described the dynamics of the battlefield as follows:

> The great increase in fire power, especially atomic weapons, has forced drastic changes in Army tactics and techniques. Armies of the future must be widely dispersed into small, self-contained units readily supported and moved for defensive and offensive operations. Divisions must be capable of sustained operations without land communications, and logistics must be rapid and flexible. The essential element of all these problems is speed: speed of movements of units, speed of arrival of supplies, speed of concentration of fire power, and speed of establishment of new or alternate lines of communication. The only answer is in the continuing and instant availability of aviation: attack aviation for concentration of fire power.[11]

Lynn Montross conversely observed that although the helicopter was one of two tactical innovations of the Korean War,[12] tactics determined the decisiveness of weapons. He wrote:

> If the experience of the centuries teaches any enduring lesson about war, it is that the heart of man has never been changed by any weapon his mind has conceived. A backward glance at the combats of pike and arquebus may seem impractical in a day of

---

[10] Theodore Wyckoff (MAJ, USA), "Mirror in the Sky," Army Journal, VI, No. 4 (November 1955), 30.

[11] William B. Bunker (COL, USA), "Why the Army Needs Wings," Army, VI, No. 8 (March 1956), 22-23.

[12] Lynn Montross, War Through the Ages (3d ed.; New York: Harper and Row, 1960), p. 989.

> intercontinental ballistic missiles. Yet the first war of the new Atomic Age was fought in Korea with weapons and tactics often reminiscent of the Western Front in 1915. Battles were won in that conflict by a reliance on principles which have not changed since the time of Alexander the Great. For in 1950, as in 331 B.C., the decisiveness of weapons depended largely on the use made of such timeless elements as preparedness, secrecy, deception and surprise.[13]

The recurring theme in each of the preceding paragraph's statements is the value of history and historical perspective in arriving at an understanding of the development of a weapon system. There is an evident relationship when the observations are examined in perspective.

## STATEMENT OF THE PROBLEM

The problem associated with this research paper encompasses tracing the introduction, evolution, and development of the advanced attack helicopter. It also encompasses documenting the influences and occurences that have brought it to its current state of the art in the U.S. Army.

## PURPOSE OF THE STUDY

The single specific purpose in this author's mind from the onset of this research endeavor was to make a scholarly contribution to the process of documenting the genesis of advanced attack helicopters. Additionally, there was a desire to make a contribution to military art and science and to satisfy personal curiosity regarding the viability of assembling unclassified documentation on

---

[13]Ibid., p. xiii.

a major U.S. Army weapon system.

Four related secondary purposes are worthy of mention. They were to prepare a timely document on a subject of vital concern within the U.S. Army, to provide for military history students a scholarly document on the attack helicopter weapons system, to assemble an extensive current bibliography, and to formulate in detail for ready reference a list of information sources such as professional societies and aircraft manufacturers.

In summary, this author's purposes were as Professor Tyrus Hillway capsulated when he wrote:

> (S)tudy the record of the past and present, first, to understand them; second, to discover facts from them; third (if they are human records), to learn something about their authors or originators; and, finally, to make generalizations (hypothesis or conclusions) about them.[14]

## METHODOLOGY

Research was conducted in the facilities of the U.S. Army Command and General Staff College Library and the Fort Leavenworth Post Library. The user-operated on-line Defense Documentation Center terminal in the former proved useful in identifying documents pertaining to the research requirement, particularly background reading and information of a general nature relating to attack helicopters.

In addition to an extensive library search for unclassified documentation, this author wrote numerous letters requesting assistance

---

[14]Tyrus Hillway, Introduction to Research (2d ed.; Boston: Houghton Mifflin Co., 1964), p. 142.

in specific areas. Addressees included, but were not limited to, COL Jay D. Vanderpool, USA, Ret.; GEN Hamilton H. Howze, USA, Ret.; LTG Harry W. O. Kinnard, USA, Ret.; BG Samuel G. Cockerham, USA, AAH Project Manager. Other addressees included two military museum curators, four aircraft manufacturers, five professional societies, and twenty-four editors, military information officers and military agencies.

In this manner a volume of general information pertaining to the helicopter in its military application was assembled. Fortuitously, as in the case of COL Vanderpool, personal papers and documentation related to the thesis were readily provided with permission granted to incorporate them as appropriate within this research endeavor. In this manner the depth and completeness of the overall research effort was enhanced by the interest in and courtesies extended by the particular individuals or agencies responding.

A complete listing of the information sources was compiled. This listing and the information solicited in turn by the author was applied to broaden the base of the research effort. Hopefully, the listing (Appendix A) will facilitate future research endeavors.

The eyewitness accounts of individuals associated with the history of attack helicopter development were included. Two warrant particular note. One individual directed and participated in the early attack helicopter experiments of the mid-1950's at Fort Rucker. In addition he was personally and professionally acquainted with many of the participants. The second directed an extensive examination of U.S. Army aviation in the early 1960's which resulted in impetus being applied to the development of attack helicopters.

In assembling narrative documentation for the thesis, efforts were simultaneously directed at collecting supporting evidence in another format, specifically, pictorial. In this regard over one hundred photographs depicting the evolution of the helicopter, or early helicopter armament subsystems, the principal agents responsible for the development process and, finally, the end result, the AAH, are included. In further support of the thesis and in order to provide additional information in still another format, the author included general arrangement drawings of four helicopters significant in this endeavor. Included also are thirteen aircraft specification summaries reflecting important characteristics of various helicopters associated with the historical process of evolution.

The investigative method used for this report employed a "documentary research" technique. In Hillway's words:

> (D)ocumentary research consists in putting together in a logical way the evidence derived from documents and records, and from that evidence forming conclusions which either establish facts hitherto unknown or offer sound generalizations with respect to past or present events, human motives, characteristics, and thoughts.[15]

In conducting research into the introduction, evolution, and development of the attack helicopter, it became immediately apparent that a chronological organization would facilitate the reporting and recording. That technique was therefore adopted for the review of the literature.

---

[15]Hillway, p. 141.

Some of the material and data necessary to support the author's presentation of information, including lengthy direct quotations which were too detailed to include in the thesis proper, are presented in Appendix B. The highlights of this appendix include: an extensive, selected chronology, a recapitulation of helicopter designations, and U.S. Army Fact Sheets on helicopters which figured in the process of evolution. In the interest of clarity and reader appreciation, acronyms, abbreviations, and definition of terms peculiar to the study may be seen in Appendix C.

## STUDY'S SCOPE AND DELIMITATIONS

This thesis primarily concerns the introduction, evolution, and development of the attack helicopter within the U.S. Army. The methodology employed delimited the scope of the treatment. The author traced the subject from the initial involvement of the U.S. Army, then the Army of the Potomac, with military aviation, to the first helicopter and thereafter to the current state of the art.

The research report does not examine from an engineering and technical viewpoint the characteristics of aircraft and weapons systems other than in a general manner to facilitate understanding. Readers interested in detailed technical and engineering data may refer to military and manufacturers' fact sheets.

## ORGANIZATION OF REMAINDER OF THESIS

A review of literature is contained in subsequent chapters organized chronologically as follows:

| | |
|---|---|
| CHAPTER II | 1860-1955 |
| CHAPTER III | 1955-1963 |
| CHAPTER IV | 1963-1975 |

This review addresses the AAH as an integral part of U.S. Army aviation and traces the process of evolution of both the helicopter itself and helicopter armament subsystems. Finally, these are coupled and developed as the AAH, thereby bringing the reader to the current state of the art.

Chapter II surveys the earliest introduction of aviation within the U.S. Army and details the initial development and potential application of helicopters within the military.

Chapter III traces the pioneering efforts of aviation visionaries and their impact upon the development of suitable military helicopters and helicopter armament subsystems. It primarily focuses on four significant aspects of the process of evolution. These are: COL Jay D. Vanderpool's accomplishments, Rogers Board, Howze Board, and the introduction of the COBRA.

Chapter IV examines the events associated with the U.S. Army's program to procure the AAFSS. It also details the program termination and reasons therefore. Finally, the reader is introduced to the AAH with the treatment terminating with the current state of the art as of January 1975.

Chapter V summarizes the study and presents the author's conclusions.

# CHAPTER II

1. Don't take the machine into the air unless you are satisfied it will fly.
2. Riding on the steps, wings, or tail of a machine is prohibited.
3. Aviators will not wear spurs while flying.[1]

## BACKGROUND

Military aviation in the United States is entwined within the history of this nation itself. This fact became evident early in the research endeavor where examining a process of evolution of an item which literally was evolved over a period of many years. The evolutionary process itself is of historical importance to the military historian. And as the item itself evolved, so did the system which fostered it. In tracing the introduction, evolution and development of the attack helicopter with the U.S. Army, the author determined that the background of military aviation should be examined for two principal reasons. First, in describing an evolutionary process one must understand the framework or organization within which the process was occurring to more fully appreciate the significance of the occurrence. Secondly, since the organization within which the evolution was taking

---

[1] Early military flying regulations, circa 1920; quoting U.S. Army Vice Chief of Staff General Creighton W. Abrams - "Aviators will not Wear Spurs While Flying," Journal of the Armed Forces, Vol 102, No. 50 (August 1965), 22.

place was itself changing a collateral or parallel examination is important if simply to insure complete clarity and understanding of the situation, i.e., military aviation.

Unless both author and reader know distinctly the type weapon system discussed as well as the specific organization and its identification, then confusion may result from communication difficulties. For example, one cannot properly refer to aviation elements within the U.S. Army prior to 1947 although helicopters were being introduced prior to this time. In tracing the introduction of the helicopter one soon learns that aviation elements with the military establishment were designated by at least seven titles. These included:

1. 1861 - Balloon Corps, Army of the Potomac
2. 1862 - Balloon Corps of the Signal Corps
3. 1907 - Aeronautical Division of the Signal Corps
4. 1914 - Aviation Section of the Signal Corps
5. 1918 - Air Service
6. 1941 - Army Air Force
7. 1947 - United States Army

Even as regards the so-called "birthdate" of Army Aviation a degree of dispute and contention exists. Some contend that meteorologist turned professor Thadeous C. Lowe's ascent over Washington in 1861, and his later designation as "Chief Aeronaut," Balloon Corps, Army of the Potomac, identifies the birthdate of Army Aviation. Others regard the authorization date of organic aviation within Field Artillery, 6 June 1942 as the important beginning. Still others trace "Army Aviation" to the National Security Act of 1947 which formed the military services as are known today and authorized organic aviation within the U.S. Army.[2]

---

[2]William K. Kay (CPT, USA), "The Army Aviation Story," Aviation Digest, Vol 7, No. 6 (June 1961), 1.

John J. Tolson, III, then a BG, writing about the evolution of aviation within the U.S. Army, traced it to the Balloon Corps of 1861 and Professor Thadeous C. Lowe.[3]

Conversely, the prestigious USAAVNS publication, the U.S. Army Aviation Digest identifies 6 June 1942 at the beginning of a listing of "Army Aviation Milestones" as follows: "6 JUN 1942. Army Aviation is born with the establishment of organic air observation units for Field Artillery units."[4]

Regardless of the personal resolution of the previous, the fact remains that the employment of aviation within a military service of the United States can in fact be traced to the Civil War period. Specifically, Professor Thadeous C. Lowe provided intelligence information to Union Forces concerning activities of Confederate Forces in proximity to Washington, D.C. Lowe managed this feat while suspended in a wicker basket beneath a varnished silk balloon.[5] Three months later Lowe distinguished himself by directing artillery fire from his balloon-suspended aerial observation post using a combination of telegraph messages and signal flags.[6]

---

[3]John J. Tolson, III (BG, USA), "Army Aviation Dates From Balloon Corps of 1861," Army Navy Air Force Journal and Register, Vol 100, No. 53 (August 1963), 81.

[4]"Army Aviation Milestones," Aviation Digest, Vol 12, No. 6 (June 1966), Back Cover.

[5]William E. Butterworth, Flying Army (Garden City: Doubleday and Co., 1971), 10.

[6]Butterworth, p. 11.

> The efficiency of Lowe's method of artillery direction over the old method was so striking that the last resistance to this innovation vanished completely. The next day, September 25, 1861, Secretary of War Edwin M. Stanton ordered the formation of the Balloon Corps of the Army of the Potomac, and named Thadeous S.C. Lowe, Esq., Chief Aeronaut.[7]

Professor Lowe in fact accomplished the practical aerial observation and aerial adjustment of artillery fire which the War Department sought to officially recognize and authorize again some eighty-one years later on 6 June 1942.[8]

> On this date the War Department approved aviation as an organic part of the Field Artillery...to supplement the existing system of air support and to provide air observation and aerial adjustment of artillery fire.[9]

In 1862 the Balloon Corps was made part of the Signal Corps. Unfortunately for Professor Lowe and his associates the Signal Corps abruptly announced "neither the funds, the experience nor the personnel for such an operation."[10] The result was the dissolution of the Balloon Corps in 1863.

> Perhaps this (neither Professor Lowe, his observers, nor his organization were military) was the major reason for the disbandment of the Balloon Corps in 1863, an act which frustrated and disillusioned the professor and his associates.[11]

The Balloon Corps reappeared thirty-five years later, 1898, with the reintroduction of a "modernized (it had a telephone, instead of a telegraph key) Civil War model balloon."[12]

Forty-six years after Professor Lowe's balloon ascent in the defense of Washington, the first formal aviation element was formed

---

[7]Butterworth, p. 12. [8]Tolson, p. 81. [9]Ibid.

[10]Butterworth, p. 12. [11]Tolson, p. 81. [12]Butterworth, p. 14.

PROFESSOR THADEOUS C. LOWE, "CHIEF AERONAUT"

U.S. Army Communications Electronics Museum

within the Signal Corps. On 1 August 1907, the Chief Signal Officer, BG James Allen established, by written directive, the Aeronautical Division of the Signal Corps.[13] "With the threat of World War I as incentive, Congress created, within the Signal Corps, an Aviation Section on 18 July 1914."[14] By this time the newly created Aviation Section was considered so "popular" that it consisted of 16 officers and 77 enlisted men.[15]

The following author's evaluation of the impact of World War I on military aviation within the U.S. military establishment establishes the milieu for a reader's appreciation and understanding of helicopter developments which were to follow.

> The United States came out of World War I with a new, but substantial aviation tradition. As it rather surprised us to suddenly become a major world power, we were surprised to find that we were now on the verge of becoming the world's leading aviation power.[16]

Refinements of aviation interests and responsibilities continued for the next thirty-three years within the U.S. military establishment. Three notable occurrences which completed the molding process are worthy of mention. The results of these occurrences refined military aviation and brought it to a point commonly recognizable as military aviation within the U.S. Army today.

---

[13] See Written Direction of BG James Allen in Appendix B.

[14] Butterworth, p. 24.

[15] War Department, Bureau of Public Relations, Press Branch, Release dated September 5, 1941.

[16] Butterworth, p. 28.

Aviation was separated from the Signal Corps on 21 May 1918 when President Woodrow Wilson created two federal agencies, the Bureau of Aircraft Production and the Division of Military Aeronautics, under the jurisdiction of the Secretary of War.[17] On 24 May 1918, Secretary of War Newton D. Baker consolidated the agencies into the Air Service. A director was not named, however, until 27 August 1918. "The Second Assistant Secretary of War was thereafter to be, ex officio, the Director of the Air Service."[18]

Anticipating the requirement for an updated aviation organization prior to the onset of World War II, Congress created the Army Air Forces.[19] Although accomplished on 20 June 1941, it was 9 March 1942 before the War Department established three co-equal commands: The Army Air Forces, The Army Ground Forces, and The Army Service Forces.[20]

The National Security Act of 1947 completed the refinement process and largely created Army aviation as known today.[21] It created the separate military services and specifically authorized organic aviation within the U.S. Army.

The information contained within the previous paragraphs capsulates the phases of refinement through which forerunners of the current aviation organization within the U.S. Army can be traced. The sections which follow specifically address the helicopter, its introduction, evolution and development as a weapons system.

---

[17]Ibid. [18]Butterworth, p. 30. [19]Tolson, p. 81.

[20]Ibid.

[21]See Extract of National Security Act of 1947 in Appendix B.

## FROM HORSES TO HELICOPTERS[22]

> To most of us a helicopter is above all the fulfillment of an ancient dream of humanity, the complete and final conquest of the air. It is a flying machine which allows the flier to do anything a bird can do, and more. In still air few birds can hover like a helicopter, and no bird can fly vertically upwards, backwards or sideways, take off straight up and land straight down.[23]

Readers interested in tracing the origin of the helicopter to its source will have a difficult endeavor, indeed, since its origin can be traced through centuries of antiquity to early Chinese experiments with a helicopter-type child's plaything.[24] U.S. military interest, however, began much later, delimiting automatically the timeframe of this research endeavor. Although relatively little known, in terms of having been documented and reported, interest of the U.S. military can be traced to activities of the Air Service and the decision of the War Department in 1917 to establish an engineering laboratory at McCook Field, Dayton, Ohio.

The first helicopter which appears to have been evaluated was the Peter Cooper Hewitt design. Evaluated in 1918 at McCook Field engineers reported possible military application for the machine.

---

[22]Gerald H. Shea (LTC, USA), "From Horses to Helicopters," Aviation Digest, Vol 1, No. 4 (May 1955), 12.

[23]Jacob Shapiro, The Helicopter (New York: Macmillan Company, 1958).

[24]Frank X. Ross, Jr., Flying Windmills (New York: Lothrop, Lee and Shepard, 1953), 2.

Evaluation of aircraft capable of vertical takeoff continued with examination of the J. E. McWorter aircraft in 1919.[25] In late fall 1919 Emile Berliner and his son, Henry, tested and demonstrated a helicopter at College Park, Maryland, an Air Service flying field. Testing continued until the spring of 1922 when Henry was almost killed in an aircraft accident due to lack of adequate control.[26]

## THE FIRST HELICOPTER

Interest in helicopter flight continued in the military establishment. This interest was centered in The Engineering Division of the Air Service at McCook Field. The Engineering Division had as its stated purpose "research and experimentation in military aeronautics and the development of the flying machine."[27] It had "carte blanche to investigate every possible invention that might contribute to military aviation."[28] Major T. H. Bane, Chief of the Engineering Division in 1920, and a small group of officers had conducted extensive research into the area of helicopter engineering as it existed at the time.[29] In so doing Major Bane was rapidly impressed with the writings and engineering studies of Dr. George de Bothezat. Major Bane is noteworthy

---

[25]Hollingsworth F. Gregory, Anything A Horse Can Do (New York: Reynal & Hitchcock, 1944), 16.

[26]Ross, p. 56. [27]Gregory, p. 18.

[28]C. V. Glines (LTC, USA), "De Bothezat's Flying Octopus," Airman, Vol VI, No. 1 (January, 1962), 43.

[29]Ross, p. 58.

in his own right, being characterized as "one of the real pioneer boosters of the helicopter for military purposes."[30] His interest in Dr. de Bothezat's theories continued to develop with exchanges of letters, meetings and, finally on 1 June 1921, a contract.[31]

> By its terms de Bothezat agreed to furnish drawings and data, to design, construct, and supervise flight tests of a helicopter. The government was to furnish supplies, materials, equipment, workmen, and construction space. There were many unusual conditions; as compensation the inventor was to get $5000 for the complete first drawings and sketches. He was to receive $4800 more for the detail (sic) design and construction and $2500 additional if the machine would rise from the ground on its own power. If it should rise three fundred feet and return safely with a descending speed of less than fifteen feet per second - about ten miles per hour - with the engine completely throttled, he would get an additional $7500. Altogether by its terms the contract involved more than $19800, to be the inventor's if his helicopter were successful. There was a time limit. The government wanted the job done by January 1, 1922. It later extended the deadline to May 31, 1922. The inventor also granted to the government the license under any developments which were devised in connection with the performance of the contract.[32]

The Engineering Division contract established a deadline for completion of work which was "too short a time even in those days for development of a new flying machine."[33]

Much has been written and is being written about Dr. de Bothezat and his contributions. In fact the personality, character and accomplishments of this individual readily facilitate scholarly endeavors in the form of thesis writing. The following quotes provide an interesting and revealing insight into de Bothezat the man, and de Bothezat, the inventor.

---

[30] Ibid. [31] Gregory, p. 19.

[32] Gregory, p. 20. [33] Glines, p. 44.

"The earliest American attempt to fly a helicopter is notable as much for the colourful (sic) personality of its inventor as for the fact that it was actually ordered by the U.S. Army. The project was promoted by Georges de Bothezat, who, in spite of his French name, was a bearded Russian nobleman with the manners of a Toreador, convinced of being the greatest man alive, and of being the only man who could fully understand the mysteries of airscrews and rotors. His four-rotor helicopter, each with six wide blades, looking rather like toy windmills, had no fundamental novelty over the earliest successful helicopter built by Breguet, and was perhaps the reason why the Americans took little further interest in helicopters until the late 30s".[34]

"A terse, short-tempered, scholarly Russian, George de Bothezat... achieved two things: he not only managed to get his helicopter off the ground, but he interested the Army Air Service in direct-lift flights as well. At a time when professional American soldiery, fresh from a war, was subsisting on short financial rations, obtaining funds from the War Department for highly experimental work was a single accomplishment in itself."[35]

The entire project was given top-secret status and shrouded in canvas fencing to discourage the curious.[36] Fabrication proceeded rapidly without benefit of models or wind tunnel testing. The helicopter was fabricated entirely from Dr. de Bothezat's design drawings facilitated by his constant presence, and built solely from mathematical calculation.[37]

The first flight took place at McCook Field on 18 December 1922. The helicopter reached an altitude of six feet and remained airborne for one minute and forty-two seconds. "This historical event gave the

---

[34]Shapiro, p. 84.

[35]Devon Francis, The Story of the Helicopter (New York: Coward-McCann, 1946), 38.

[36]Glines, p. 44.

[37]N. de Transihe, "The Genius of Dr. George de Bothezat," American Helicopter, Vol XXXXVII, No. 8 (July 1957), 8.

United States its first accomplishment in the helicopter field."[38] Over one hundred flights followed eventually with two passengers, then with four. An endurance record of two minutes and forty-five seconds was established.[39] The Engineering Division had spent about $200,000 in the effort with the de Bothezat helicopter.[40] In spite of this, however, the aircraft was "thought to be too complicated in structure to care for properly...also far too difficult to fly."[41] The contract was terminated.

The significance of the early efforts of the Engineering Division of the Air Service are speculative, however, the evaluation of one author is particularly enlightening.

> The de Bothezat episode is significant only in the light of what it subsequently led to - the construction by the same inventor of a much simpler, more compact helicopter of which it was testified before the House Military Affairs Committee: 'This would give rise to an entirely new method of warfare, battalions of swift and silently-flying machine guns, able to land at night behind the enemy's lines, even in rough country.'[42]

The overall effect of the cancellation of the de Bothezat project and interest in military application of the helicopter was adverse as evidenced by the following statement. "When the Army dropped the de Bothezat helicopter, enthusiasm in the further development of such craft waned for several years."[43]

---

[38]Ibid. [39]Glines, p. 45. [40]Gregory, p. 29.

[41]Ross, p. 62. [42]Francis. p. 40.

[43]Gregory, p. 30.

U.S. ARMY'S FIRST EXPERIMENTAL HELICOPTER
IN FLIGHT DESIGNED BY DR. DE BOTHEZAT
AND FLOWN AT MC COOK FIELD

American Helicopter

## THE AUTOGIRO

Military interest in the helicopter declined, however, engineering, development and testing of aircraft continued into 1930 and beyond. In 1930 and 1931 the military tested an autogiro. Although the aircraft had potential application, it was not entirely suitable. Further development, however, satisfied military requirements and the autogiro was purchased.[44] Although the military had committed itself to the autogiro, including purchase of aircraft and establishment of training facilities, the autogiro did not possess the qualities which were characteristic of the helicopter. The design and performance characteristics of the autogiro and helicopter classified them as distinct types of aircraft. The autogiro, fortuitously, expanded interest in vertical flight although it could not itself fly vertically. The autogiro provided a bridge between early helicopter experiments and subsequent experiments which would eventually provide a military helicopter. The importance of the autogiro as a phase in the successful development of the military helicopter is evident in the following statement.

> Yet in the Autogiro we had seen a way to vertical flight and to many of us it seemed the next step toward the helicopter. Primarily this was the reason for the Army's gyro school and its exhaustive research into rotary-wing aircraft.[45]

---

[44] Gregory, p. 39.

[45] Ibid.

# THE KELLETT AUTOGIRO

American Helicopter

## THE SECOND HELICOPTER

On 30 June 1938 Congress appropriated $2,000,000 to continue research and development for rotary and fixed wing aircraft.[46] The response from industry, which at the time consisted of many private individuals interested in aviation, provided added incentive for further development. On 19 July 1940 the Assistant Secretary of War approved award of a contract for the military's second helicopter to the Platt-Le Page Aircraft Company.[47] The aircraft actually was already under construction by the company. Its fuselage was conventional in appearance, but its rotor system was not. Fixed at the end of wing-like pylons were counter-rotating rotors thirty and one-half feet in diameter. The power plant was located in the center of the fuselage, totally enclosed, at a point where the pylons joined the fuselage. The crew compartment was enclosed in transparent plastic.

The Platt-Le Page tandem rotor helicopters, XR-1 and XR-1A, proved successful. Colonel Gregory, a military evaluator and test pilot associated with the project, evaluated it in this manner.

> The XR-1 had definite successful features: an interior engine installation with proper cooling, trouble-free transmission, long shaft drives free of vibrations, and rotor hubs and gears which operated satisfactorily.[48]

As a precursor of current advanced attack helicopters, at least as regards configuration of crew seating, the XR-1A provided for tandem seating with the observer in front of the pilot.

---

[46]Gregory, p. 98. [47]Gregory, p. 100. [48]Ibid.

PLATT-LE PAGE TWIN ROTOR HELICOPTER XR-1

American Helicopter

## THE HELICOPTER COMES OF AGE[49]

The origin of the Army Air Forces first successful helicopter can be traced to a Russian immigrant, Igor I. Sikorsky.[50] While Havilland H. Platt and W. Lawrence Le Page continued to refine the XR-1, ultimately producing the XR-1A, a rival aircraft of entirely different design had "won the right to be known as the first practical American helicopter."[51]

After wrestling with design, power plant, rotor systems, anti-torque devices and configuration for thirty years, Igor I. Sikorsky impressed Army Air Force observers with a previously unparalleled helicopter flight. On 6 May 1941 with Sikorsky piloting his VS-300, the helicopter actually remained aloft for 1 hour, 32 minutes and 26.1 seconds. The significance of this occurrence is revealed in the following statements.

> This was enough to convince the Army Air Forces that there was enough of an idea in rotary wing aircraft to merit an injection of the taxpayer's dollars.[52]

> Tests conducted...indicated that his (Sikorsky's VS-300) showed more promise than any helicopter ever built before in the United States.[53]

> (T)he (VS-300) became the prototype for the first production line of helicopters and emerged as the first helicopter to be used by armed forces in various theaters of war.[54]

---

[49]Ross, p. 127. [50]Gregory, p. 110. [51]Montross, p. 30.

[52]Butterworth, p. 47. [53]Montross, p. 30. [54]Shapiro, p. 92.

IGOR I. SIKORSKY

> The Army had a successful helicopter. (It) was a successful and practical helicopter, capable of true vertical flight, hovering, forward, backward, and sideways flight...[55]

On 6 May 1942 Igor I. Sikorsky personally delivered the first U.S. military helicopter to the Army Air Forces.[56] Designated The Sikorsky R-4 it was smaller than both the Platt-Le Page and de Bothezat helicopters. But it was practical and successful. Its 180 horsepower engine, coupled by V-belts to a 28 foot diameter main rotor system and an antitorque tail rotor, lifted the helicopter weighing 2,500 pounds, and a pilot. Under specific conditions it was capable of carrying one passenger "although it was not capable of hovering with full load except under favorable conditions."[57] The helicopter had a useful fuel capacity and endurance of five hours. Its powerplant permitted it to climb to an altitude of 5000 feet in seven minutes or attain a speed of 100 miles per hour.[58] The helicopter rotor system enabled a pilot to accomplish a vertical or near vertical safe descent in the event of engine failure.[59]

The age of the helicopter and its military application had arrived, albeit in its infancy. Total military application of the helicopter was a concept to be appreciated by military visionaries as evidenced by the following evaluation.

> It (6 May 1942) was a momentous occasion in world history. It got less space in the newspapers than publicity photographs of a jeep bouncing through the air, and nowhere near so much space as free glossy pictures of Lana Turner's upturned legs.[60]

---

[55]Gregory, p. 124. [56]Butterworth, p. 48. [57]Shapiro, p. 92.

[58]Montross, p. 32. [59]Francis, p. 126. [60]Butterworth, p. 61.

THE FIRST PRACTICAL HELICOPTER

IGOR I. SIKORSKY (LEFT) CONGRATULATES COL H. FRANKLIN GREGORY, U.S. ARMY AIR CORPS, AT THE MAY, 1942 ACCEPTANCE OF THE XR-4 AT WRIGHT FIELD AS ORVILLE WRIGHT (CENTER) LOOKS ON

FIRST R-4 FOR INSTRUCTIONAL PURPOSES

Army Aviation

## THE IMPACT OF SIKORSKY

Igor Sikorsky has been the subject of numerous books, articles and comments. The underlying theme of the majority of the writing and comments has been the contributions which Sikorsky made to helicopter evolution. The following statement is typical.

> Probably the most famous name in modern helicopter history is that of Igor Sikorsky...He is considered dean of the helicopter industry and has probably done more than any one man to bring it to its present stage of development in this country.[61]

Although the helicopter was still considered "too experimental"[62] during World War II to receive the degree of attention which proven fixed-wing aircraft did, development continued with subsequent Sikorsky helicopters and additional manufacturers building them. Sikorsky expanded production and produced the XR-5 and XR-6 capitalizing on the successful XR-4. Other names, later to become synonymous with successful helicopters appeared, Bell Aircraft Corporation and Frank N. Piasecki, of Piasecki Helicopter Corporation. Other manufacturers included: Kaman Aircraft Corporation, Hiller Helicopters, Kellett Aircraft Corporation, Hughes Aircraft Corporation, Gyrodyne Company of America.

Even during World War II the visionaries within the military began to speculate on the potential employment of helicopters as aerial weapons platforms. COL Gregory, himself a military aviation pioneer

---

[61] Samuel C. Williams, Report on the Helicopter (New York: Edwards Brothers, Inc., 1956), 17-18.

[62] Ibid.

# FRANK N. PIASECKI, AVIATION PIONEER RESPONSIBLE FOR DEVELOPMENT OF H-21 TANDEM ROTOR HELICOPTER

U.S. Army Aviation Digest

FIRST ACCEPTANCE OF TWIN ROTOR AIRCRAFT BY THE ARMY: AUGUST 20, 1954, WITH MG PAUL F. YOUNT, CHIEF OF TRANSPORTATION CORPS, ACCEPTING THE FIRST U.S. ARMY H-21C HELICOPTER AT THE MORTON, PENNSYLVANIA PLANT OF THE PIASECKI HELICOPTER COMPANY. FRANK N. PIASECKI (LEFT) LOOKS ON

THIS HELICOPTER LATER TO FIGURE PROMINENTLY IN ATTACK HELICOPTER DEVELOPMENT

was one of the first military members to fly the Sikorsky VS-300, later the R-4. In fact he accepted it into the inventory as the first practical military helicopter.[63] He authored the following in 1944.[64]

> Armed Combat - There has been some speculation as to the possibilities of arming the helicopter. (T)he performance of the craft is dependent upon keeping it as light as possible. Application of conventional machine guns or aircraft cannon would mean much additional weight. Such installations, however, have been under study.
>
> Rocket guns, because they are compact and light for the wallop of their fire, might be a possibility. A helicopter thus equipped would be deadly against ground installations because its slow speed would provide for time to use sighting devices. It also would have an element of surprise, for the ship would drop from out of nowhere and operate as an "Indian fighter" from behind large hills or other secluding obstacles.[65]

Although a practical and successful helicopter had been introduced in 1942 it was not widely employed in World War II. The following summarizes the employment of the available, meager helicopter assets in support of military operations during the war years.

> The fact was that the development of a practicable American helicopter had come too late for World War II. A few Sikorsky and Platt-Le Page aircraft saw Army Air Corps field duty during the last months in the rear areas of such widely separated fronts as Europe, Burma, Okinawa, New Guinea, and the Philippines. Rescue, liaison, and supply missions were reported, but for the most part the U.S. combat forces seemed to regard the helicopter of 1945 as a fascinating

---

[63] Melville M. Zemek, "First Cross-Country," Army Aviation, Vol 17, No. 5 (May, 1968), 4-6.

[64] Gregory, p. 242.

[65] Author's note: COL Gregory retired as a BG after 30 years military service during which he had dedicated himself to the "organization and development of a myriad of Air Corps technical projects". He served in command assignments during and after World War II. In 1952 he was assigned as Air Attache in the American Embassy, Paris. Upon his retirement in October 1958, BG Gregory was Commander of the Air Force Office of Scientific Research. (Source: Melville M. Zemek, "First Cross-Country," Army Aviation, Vol 17, No. 5 (May, 1968), 4-6.)

> aeronautical freak, useful for running administrative errands... The helicopter, in short was still in its tactical swaddling clothes when World War II ended, and the problems of bringing the infant up to maturity were left for the future.[66]

> In 1942, when the Air arm was an adjunct of the Army, further studies were made leading to the design of a 20mm cannon installation in the nose of the aircraft. The problem, however, was not studied exhaustively in its operational aspects; and with the creation of a separate Air Force, no further exploitation of this budding idea of an aircavalry vehicle was undertaken.[67]

## IMPROVING THE DETAILS

In the years subsequent to the introduction of the military's first successful helicopter, specifically 1942 to the end of the Korean War, there were two general influences providing impetus to further helicopter development and employment variations. The following capsulates these influences.

> 1 - After World War II, and because of developments in atomic warfare, the military became interested in the helicopter as a carrier.[68]

> 2 - Outbreak of war in Korea in 1950 again called for concentration of all aviation efforts in the military field.[69]

It would prove argumentive, indeed, to attempt to report with firm conviction the exact service, date, time, aircraft and weapon which

---

[66] Lynn Montross, Cavalry of the Sky, (New York: Harper & Brothers, 1954), 34.

[67] Ed Katzenburger, Chief of the Advanced Design Branch, Sikorsky, "History and Significance of Helicopter Armament," contained within "Helicopter Armament" Technical Papers Presented at the American Helicopter Society's Fifth Annual New England Regional Clambake, August 26 and 27, 1961, Burlington, Vermont, p. 13.

[68] Williams, p. 18. [69] Ibid.

AS EARLY AS 1942 A 20 MILLIMETER CANNON INSTALLATION WAS UNDER CONSIDERATION FOR THE SIKORSKY R-5, HOWEVER, THE PROGRAM WAS DROPPED WITH THE CREATION OF A SEPARATE U.S. AIR FORCE IN 1947

would justify and satisfy the claim to the first armed helicopter. In the post World War II years with the atomic capabilities which this nation possessed and with the effects of the National Security Act of 1947 influencing the new separate services, the development of airpower took a direction more and more divorced from the immediate needs of the ground commander.

> While the USAF was flying higher and faster with the development of the Strategic Air Command, little was done for the ground combat soldier in the way of providing him with mobility and close air support.[70]

General Hamilton H. Howze related the following in regard to the "first armed helicopter."

> I am told that the first recorded test of an armed helicopter took place at Wright Field in 1942. The ship hovered carefully over a target and at the appropriate moment a 25-pound practice bomb, carried in the lap of a passenger, was flung overboard. Because it was inert the bomb didn't blow the helicopter out of the air.[71]

Lynn Montross reported that it was a group of enterprising Naval and Marine Aviation personnel which undertook helicopter armament experiments as early as May 1950. LTC George W. Herring and MAJ William P. Mitchell experimented with a bazooka fixed to the skid of a Bell helicopter. The special 3.5 inch rocket-launcher mount, controlled from the cockpit, designed and installed at the Naval Air Development Center, Johnsville, Pennsylvania, was test fired on 29 August 1950.[72]

---

[70]Department of the Army, USAARMS, Command and Staff Department, "Historical Manuscript-Attack Helicopter Units," undated, p. 1.

[71]Hamilton H. Howze (GEN, USA), Ret., "COBRA," Reprinted from Verti-Flite, Vol 13, No. 9 (September 1967), 1.

[72]Lynn Montross, Cavalry of the Sky (New York: Harper & Brothers, 1954), 104.

1950 EXPERIMENT BY THE U.S. ARMY AND BELL HELICOPTER
MOUNTING A BAZOOKA ON AN OH-13 HELICOPTER

U.S. Army Aviation Digest

> It was established that the bazooka blast would clear all parts of the aircraft...then, on August 29 (1950), a 3.5 "rocket was successfully fired from the right skid of the little utility helicopter.[73]

## USMC ACTIVITIES

The Korean War provided impetus to the employment of helicopters in combat. When the First Marine Brigade landed in Korea in August 1950 it had six organic helicopters. "It was the first military unit in history to employ helicopters in combat."[74] One year later an aviation milestone was reached.

> On 21 September 1951, the idea of vertical envelopment by helicopter became a reality when a company of United States Marines was airlifted by helicopter to the summit of Hill 884 in Korea.[75]

Montross reports the employment of free-fire automatic weapons from USMC helicopters in Korea in October 1951. The weapons were not fixed to the helicopters, rather they were carried and fired by assigned gunners, who, upon exiting the helicopter, took the weapon leaving the helicopter unarmed.

> Two BAR men were included in each destruction team, but the planners had not anticipated the air-ground fire fight which took place after several NK guerillas were flushed out by a team that had just landed. The helicopter aloft, upon being notified by radio, opened small-arms fire on an enemy who returned the complement. No harm resulted on either side.[76]

---

[73] Montross, p. 104-105.

[74] Archie J. Clapp (MAJ, USMC), "Their Mission is Mobility," Military Review, Vol XXXIII, No. 5 (August 1953), 11.

[75] Clapp, p. 10.

[76] Montross, p. 174-175.

Still another author describes union of weapons and helicopters and places their genesis in the mid-1950s.

> Except for some sporadic and undocumented testing by the Marine Corps, nothing much had been done about use of the helicopter as a weapons platform. AFF Board Project No. AC-951 stated that the helicopter was too unstable to bear consideration as a suitable weapons platform. But a resolute group at the Army Aviation School did not think so and organized a Sky Cav platoon more than a year ago. This represented more than a mere mounting of weapons on helicopters. It was the birth of an entirely new tactical concept to give the Army a potent unit for use on the atomic or non-atomic battlefield.[77]

Project AC-951 resulted from the interest expressed by General Mark W. Clark regarding the feasibility of arming Army aircraft for special missions.[78] The potential which Project AC-951 had in influencing relatively early development of armed helicopters was severely degraded by the emerging roles and missions controversy between the USAF and U.S. Army as seen in the following statement.

> Long before the project was completed, armed Army aircraft became a high-level policy issue. The Army dropped the project until 1954 when it was revived under the title of "Able Buster" at Camp Rucker, Ala.[79]

## FRENCH ARMY INFLUENCE

Numerous authors attribute the initial arming of helicopters to the French Army in the mid-1950s. In this regard the "pioneering"

---

[77]John W. Oswalt (LTC, USA), "Shooting Copters, Why and How Army Aviation Arms for Battle," Army, Vol 8, No. 10, (May 1958), 40.

[78]Ibid.

[79]Bill G. Lockwood (MAJ, USA), "Evolution of the Armed Helicopter," U.S. Army Aviation Digest, (November 1963), 40.

efforts of the French have been widely acclaimed. Major Bill G. Lockwood writing about the evolution of the armed helicopter characterized French accomplishments as follows.

> The French Army, fighting guerrilla-type warfare in North Africa in the mid-50s was probably the first to use armed rotary wing aircraft with any degree of success.[80]

Major General William J. Maddox, Jr., writing about the status of helicopters, their arming and employment said the following in characterizing the French.

> Down at LeLuc in the scrubby hills just north of Hyere on the French Riviera, an H-21 sits on a concrete pedestal at the entrance of the French Army's Aviation Training Center.
>
> It is a relic of the bitter combat in Algeria which was conducted before the U.S. Army really got its airmobility program into the air. The French military aviator is proud the (sic) H-21 on that concrete pedestal and he hasn't forgotten that he pioneered in helicopter warfare, both in its mobility aspects and in its fire power.
>
> The French fired SS-11 missiles from helicopter platforms in Algeria and they also operated fixed machine guns and hand-held door guns in the mid-1950s.[81]

The USAARMS, currently proponent for the attack helicopter, the ACCB, and the Air Cavalry Troop/Squadron, and Attack Helicopter Company/Battalion ascribes to the French Army in Algeria the following notoriety.

> (A)n enterprising French unit commander decided to arm a helicopter when his troops were pinned down by a rebel fire from a hillside above his position. The commander elected to strap a man with an automatic rifle on each of the two litters attached to the sides of an observation helicopter. The imaginative application worked; the rebels were routed by the automatic weapons, and the

---

[80] Lockwood, p. 40-41.

[81] William J. Maddox, Jr., MG, USA, "Training vs Talking," Army Aviation, Vol 23 No. 8, (August-September 1974), 9.

> French occupied their objective shortly thereafter. This may have been the first helicopter fired in combat, but certainly not the first armed.[82]

The French describe the timeliness of their own efforts in arming helicopters as follows.

> It would appear that the first time for the armed helicopter came-in-time around the mid-1950s; the place, in the heart of the Aures, a group of peaks in the Atlas Mountains in Algeria.
>
> The pilot thought he could carry two men with automatic rifles. Moreover, he was barely five minutes' flight time away from the place where the French riflemen were engaged. Two soldiers volunteered for the mission, and they were firmly fastened on the lateral stretchers, their automatic rifles pointed forward. Twenty minutes later, astonished at receiving direct fire, the enemy pulled out in confusion.[83]

Arming of helicopters continued after this initial success as evidenced by the following.

> H-21s were fitted with four machine guns and thirty-eight 68mm rockets. During the final approach prior to landing, this helicopter was supposed to sweep the landing zone with machine gunfire and rocket blasts...This was reliable but when so equipped the H-21 could not carry anything but the pilots.
>
> The next solution was to arm the Alouette helicopter...It was armed with two containers, each one having 18 or 36 rockets of 37mm according to the mission. The 37mm is a new kind of rocket - very reliable.[84]

## BEYOND 1950

Armed helicopter experiments were not widespread in the U.S. Army in the early 1950s. Bell Helicopter and the U.S. Army had

---

[82]Department of the Army, USAARMS, Command and Staff Department, "Historical Manuscript - Attack Helicopter Units," undated, p. 1.

[83]J. Pouget (MAJ, French Army), "The Armed Helicopter," Military Review, Vol XLIV, No. 3 (March 1964), 81-82.

[84]Hilaire Bethouart (MAJ, French Army), "Combat Helicopters in Algeria," Marine Corps Gazette, Vol 45, No. 1 (January 1961), 41.

experimented by mounting a bazooka on an OH-13 in 1950.[85] Later in 1951 it was test fired successfully by the USMC. The Korean War provided impetus for arming helicopters. The initial impetus was insidious, an apparent reaction on the part of aviators in the theater of operations as evidenced in the following.

> The first armed helicopter in combat was probably devised during the Korean War when the helicopter received its baptism of fire in the early 1950s. Aviators are known to have fired their weapons from the open doors of helicopters. These were not the first attempts to arm helicopters, but they reflect the spirit behind the armed helicopter's evolution.[86]

Experimentation with armed helicopters continued at a pace dictated by the imagination and industry of aviation associated individuals. The Japan-based 24th Infantry Division mounted vertical tubes filled with hand grenades on the side of a helicopter. Project "Sally Rand" was undertaken testing a stripped-down Hiller helicopter in an armed role using 5-foot, then 10-foot rocket tubes. The system was not adopted and the aircraft was not purchased.[87]

The Korean War ended without heralding significant advances in development of attack helicopters. The U.S. Army, however, was approaching the threshold of interest in and development of a helicopter weapons system. The increased power and dependability of helicopters, experiences in Korea, and French and British developments served as a catalyst as seen in the following evaluation.

---

[85]Charles O. Griminger (LTC, USA), "The Armed Helicopter Story Part I: The Origins," U.S. Army Aviation Digest, Vol 17, No. 7 (July 1971), 15.

[86]Ibid. [87]Ibid.

EARLY ARMED HELICOPTER, FRENCH ARMY VERSION

> After Korea many senior commanders restudied the lessons of that war and compared actual campaign operations with hypothetical air-mobile operations under the same conditions. Various Army aviators and members of the helicopter industry were keeping a close watch on the French and British helicopter operations in Algeria and Malaysia.[88]

The significance of the post Korean War era in the development of helicopter operations in general and attack helicopters in particular is revealed in the following statements.

> The mid-fifties were gestation years for new tactics and technology.[89] Before 1955, helicopter armament system experiments were being conducted...but, their results were anything but conclusive.[90]

In 1955, in conjunction with Exercise SAGEBRUSH in Louisiana, an experimental concept employing helicopters for reconnaissance and security was evaluated. "It led to a jurisdictional argument with the Air Force."[91]

> The Sky Cavalry concept was to impose a light transport helicopter company on the armored reconnaissance battalion of the armored division. It was basically a ground unit assignment with aircraft to facilitate its mission, providing observation, some mobility and battle area surveillance. But no attempt was made to arm the helicopters.[92]

At least one evaluator viewed the unfavorable afteraction report "written by nonaviation evaluators" as a "setback for the armed helicopter."[93]

---

[88]Department of the Army Vietnam Studies, "Airmobility 1961-1971," by John J. Tolson (LTG, USA), 1973, p. 4.

[89]Ibid.

[90]Department of the Army, USAARMS, Command and Staff Department, "Historical Manuscript - Attack Helicopter Units," undated, p. 2.

[91]Army Navy Air Force Journal, "Army Tests Heavily Armed Sky Cav 'Copter; 42 Rockets, 9 Machine Guns, 2 Cannons," Vol 95, No. 9 (November 1957), 4.

[92]Lockwood, p. 41. [93]Griminger, p. 15.

THE 24th INFANTRY DIVISION EXPERIMENTED WITH A MAKESHIFT GRENADE LAUNCHER IN JAPAN IN 1953

U.S. Army Aviation Digest

PROJECT "SALLY RAND" EQUIPPED A HILLER YH-32A HELICOPTER
WITH TWO INCH ROCKET TUBES TO TEST THE POTENTIAL
OF A STRIPPED DOWN ARMED HELICOPTER

U.S. Army Aviation Digest

## ACCOMPLISHING THE INEVITABLE

In June 1956 BG Carl I. Hutton instigated experiments in arming helicopters. Reported to have been disappointed at the outcome and afteraction report concerning the employment of Sky Cav during Exercise SAGEBRUSH, BG Hutton undertook armed helicopter experiments while in command of the USAAVNS.[94] In retrospect the initial experiments were considered "crude" since the developers were "scrounging discarded hardware from the other services' junkyards."[95]

BG Hutton envisioned a force, one hundred percent mobile and with an improved firepower ratio.[96] The special project of BG Hutton was assigned to an officer, COL Jay D. Vanderpool, who had developed an interest in helicopters in World War II and Korea. COL Jay D. Vanderpool was not himself an aviator but a "guiding genius" and a "colorful officer."[97]

COL Vanderpool's own words reveal both the character of the man and the manner in which he commenced armed helicopter experiments.

---

[94] Ibid.

[95] Department of the Army Vietnam Studies, "Airmobility 1961-1971," by John J. Tolson (LTG, USA), 1973, p. 6.

[96] Department of the Army, USAARMS, Command and Staff Department, "Historical Manuscript - Attack Helicopter Units," undated, p. 2.

[97] Department of the Army Vietnam Studies, "Airmobility 1961-1971," by John J. Tolson (LTG, USA), 1973, p. 6.

> Our basis or excuse for action was a training memorandum from General Willard Wyman in the Continental Army Command directing the development of highly mobile task forces with an improved ratio of firepower to manpower for employment on the nuclear battlefield. GEN Wyman did not tell us to use armed helicopters, but neither did he tell us not to. We went to work using our local resources. On 13 July 1956 GEN Wyman formally approved our experimentation, providing we coordinated with the U.S. Army Infantry School at Fort Berning, Ga.[98]

In June 1956, COL Vanderpool commenced the special project "with two officers, two enlisted men, unbounded enthusiasm...without a charter, without money and, by explicit direction, without publicity."[99]

As an evaluation of this aviation milestone the following is interesting.

> The armed helicopter has borne a "bar sinister" on its shield since its inception. Even today its legitimacy is by no means universally recognized. But it is welcome to the family reunion. Assembled from the surplus junkyards of World War II, the armed helicopter was born in a non-sterile garage at Fort Rucker. Midwife-without-license was Colonel Jay Vanderpool. Some said the birth was premature. Some said it was a mongrel and should be drowned to keep the breed pure. Most people doubted its survival. The prognosis was poor.[100]

---

[98] Jay D. Vanderpool (COL, USA), Ret., "We Armed The Helicopter," U.S. Army Aviation Digest, Vol 17, No. 6 (June 1971), 4.

[99] Department of the Army Vietnam Studies, "Airmobility 1961-1971," by John J. Tolson (LTG, USA), 1973, p. 6.

[100] J.J. Brockmeyer (MAJ, USA), Office Director of Army Aviation, ODCSOPS, Department of the Army, "The Concept of the Armed Helicopter," contained within "Helicopter Armament" Technical Papers Presented at the American Helicopter Society's Fifth Annual New England Regional Clambake, August 26 and 27, 1961, Burlington, Vermont, p. 1.

COLONEL JAY D. VANDERPOOL

JAY D. VANDERPOOL
COL, USA, Ret.

LEFT TO RIGHT: GEN WILLARD WYMAN, COMMANDING GENERAL, CONTINENTAL ARMY COMMAND; BG CARL I. HUTTON, COMMANDING GENERAL, USAAVNS; BG BOGARDUS S. CAIRNS, SUCCESSOR TO BG HUTTON

"Three men with vision and guts who launched air cavalry 1955-56-57-too bad Gen Gavin was not in picture,"
COL Vanderpool

(Based on personal correspondence between COL Vanderpool and the writer.)

JAY D. VANDERPOOL
COL, USA, Ret.

"BG CARL I. HUTTON (WHO) TRIGGERED ARMED HELICOPTER DEVELOPMENT AS COMMANDANT OF USAAVNS"---COL Vanderpool

(Based upon personal correspondence between COL Vanderpool and the writer.)

## CHAPTER III

## RECOGNIZING THE NEED, DEFINITE ACTION[1]

In COL Vanderpool's own words, "helicopter armament was inevitable."[2] In June 1956 he commenced a program of gradually expanding complexity in initial helicopter armament. As director of the combat development office of the USAAVNS, COL Vanderpool accompanied by LTC F. C. Goodwin requested helicopter armament feasibility data from the General Electric Company.[3]

Another description of this occurrence is enlightening in its portrayal of the manner in which COL Vanderpool accomplished his mission of producing an armed helicopter.

> As experiments continued at Ft. Rucker, Colonel Jay D. Vanderpool (who had been assigned the project of developing and testing helicopter weapons systems) and Lieutenant Colonel F. C. Goodwin visited the General Electric Company in Burlington, Vt. They consulted with GE engineer Thurwood T. Mayhood. Armed with only a drawing on a paper napkin and no money, COL Vanderpool asked GE to build a rocket kit for a helicopter. After conferring with his associate, Jack Harding, Mayhood agreed to build the kit and promised it in 3 months.[4]

---

[1]Thurlow T. Mayhood and Henry G. Benis, General Electric Missile Production Section, "Helicopter Armament," reprinted from the October 1960 issue of American Helicopter Society Newsletter, p. 2.

[2]Vanderpool, p. 2. [3]Mayhood and Benis, p. 2.

[4]Charles O. Grilminger (LTC, USA), "The Armed Helicopter Story Part IV," U.S. Army Aviation Digest, Vol 17, No. 10 (October 1971), 19.

GENERAL ELECTRIC GROUND FIRE SUPPRESSION KIT: TWO 7.62mm M-60 MACHINE GUNS, AND ONE 89mm ROCKET LAUNCHER; WEIGHT FULLY LOADED, 270 POUNDS; MAXIMUM EFFECTIVE RANGE, 1000 METERS; PRIMARILY USED WITH THE OH-13.

The following narrative reveals the enthusiasm, initiative, and imagination of the individuals associated with COL Vanderpool's project.

> The request started a period of intensive research and design effort to adapt current weapons to the helicopter mission. Armament adaptation has included 1.5-inch to 5-inch rockets, .30 caliber to 22mm machine-guns and even a B-29, twin-.50 turret. These applications have been proven singly and in combination.
>
> Installations have been both fixed and flexible, including remote control mounts. Sighting has advanced from the "gum on the windshield" stage to a sophisticated gyro-computer, capable of accepting handset inputs to be computed into the firing problem.
>
> These advances could not have been made without the dedicated effort of the few Army personnel who recognized the need and took definite action to fill the need. The early days of helicopter armament were tedious and disheartening as idea after idea has to be scrapped because of unforeseen installation difficulties.
>
> Pilots were wounded by projectile debris deflected into the cockpit; plastic bubbles shattered from recoil forces and the first rocket-powered helicopter was inadvertently developed when the rockets on a Sioux hung up after being fired.
>
> This was also the period when Army pilots were a familiar sight in the graveyards of World War II aircraft, reclaiming guns, mounts, sights, feed systems--anything and everything that might conceivably be worked into a helicopter kit. Officers and enlisted men became expert machinists, learning during the day and building during the night.
>
> The clock practically stopped for this small group of dedicated men as they worked and reworked towards the day they could demonstrate and prove their theory.[5]

Mr. Jac Weller, widely-traveled, widely published author of weapons and tactics articles, characterized early helicopter armament experiments thus.

> Early in 1957, Browning air-cooled MG's were secured to the skids with bailing wire and aimed by means of lollipop sticks taped around the pilot's and copilot seats. Rockets were secured similarly in

---

[5] Mayhood and Benis, p. 2.

IN THE EARLY EXPERIMENTS ALL DID NOT ALWAYS GO AS PLANNED, AS AN EXAMPLE OF THIS, THE ACCOMPANYING PHOTOGRAPH DEPICTS A TEST OF THE 2.75 INCH FFAR SYSTEM. IN THIS TEST SOME OF THE ROCKET TUBES WENT WITH THE ROCKETS SINCE THE EXPERIMENTAL SYSTEM DID NOT ALLOW FOR THE NECESSARY EXPANSION.

ANOTHER EXAMPLE OF A MALFUNCTION OF AN EXPERIMENTAL SYSTEM: IN THIS CASE A SHORT CIRCUIT ON A TWO INCH ROCKET SYSTEM FIRED ALL ROCKETS AT ONCE CAUSING OXYGEN STARVATION OF THE ENGINE.

> fixed positions. These early weapons could be aimed only by aiming the entire aircraft. Unstable flight characteristics and recoil sometimes led to extreme inaccuracy.[6]

Cautiously COL Vanderpool and his personnel disproved previous studies "which had concluded that the helicopter was too unstable to be employed as a weapons platform. The studies were wrong."[7] In addition to continuing experiments and refinements, COL Vanderpool began study of "armed airmobile tactical organizations or formations..."[8] COL Vanderpool clearly identified this latter requirement as "our real objective."[9]

The Selected Chronology (Appendix B) details the helicopter organizations which emerged as a result of these early efforts. The weapons systems which evolved from the Vanderpool experiments are shown in the photographs which accompany this endeavor.

In evidence of the exhaustive effort which was entailed in the early armed helicopter experiments, the following is revealing.

> From 1956 to 1959 we scoured the country looking for weapons to test on helicopters. Any idea that looked reasonably feasible was tried. We mounted weapons on every type of helicopter available to the school. We employed obsolescent, standard and prototype weapons. Our friends in industry and the Army's arsenals pitched in to help. The Navy let us have everything we asked for except the Bullpup, which they later test fired from a helicopter. The Air Force, at lower levels, was very helpful providing us with supplies and advice.[10]

---

[6]Jac Weller, "Gunships Key to a New Kind of War," The National Guardsman, Vol XXII, No. 10 (October 1968), 3.

[7]Vanderpool, p. 5. [8]Ibid. [9]Ibid.

[10]Vanderpool, p. 24.

# EARLY GUN SIGHT, CIRCA 1956

JAY D. VANDERPOOL
COL, USA, Ret.

GYRO-STABILIZED SIGHT FOR COBRA FOR FIRING
TOW MISSILES.

Hughes Aircraft Company

COBRA GUNNER'S COCKPIT. CO-PILOT/GUNNER'S COCKPIT OF AH-1G CONTAINS THE FLEXIBLE FLOOR-MOUNTED PANTOGRAPH SIGHT WITH JUMP COMPENSATION AND SIDE ARM FLIGHT CONTROLS.

Bell Helicopter

> By 1958 we had our own machine shop. We had collected over 1,000 guns and hundreds of bits and pieces of rocket pods, gunsights, intervalometers, etc. With 100 blacksmiths we soon had an armed helicopter company ready to fight.[11]

First, in June 1956 Brigadier General Hutton asked COL Vanderpool to commence helicopter armament experiments. The following reiterates the resources and situation in which he began his labors.

> There were only a few helicopters, a few guns and rockets, and no sights. But he had one big asset--a group of dedicated aviators and enlisted men willing to donate their free time to his cause. This team of men became known as "Vanderpool's Fools." They worked long days and through weekends developing helicopter weapons systems. They all worked under pressure as there was a feeling that the whole project might be cancelled before they proved their concept.[12]

Next, the following narrative by a general officer further amplifies the situation in which COL Vanderpool excelled in his efforts to arm a helicopter.

> With borrowed personnel from the Department of Tactics, Colonel Vanderpool formed a "sky-cav" platoon which became notorious for its hair-raising demonstrations of aerial reconnaissance by fire. By mid-1957 this provisional unit, redesignated Aerial Combat Reconnaissance Platoon, had somehow acquired two H-21's, one H-25, and one H-19 armed with a wondrous variety of unlikely weapons. Colonel Vanderpool and his "hoods" were to see their efforts officially recognized when the Aerial Combat Reconnaissance Platoon became the nucleus of the 7292d Aerial Combat Reconnaissance Company (Provisional) with an approved Table of Distribution sanctioned by the Department of the Army on 25 March 1958.[13]

---

[11]Vanderpool, p. 28. (Author's Note: The accomplishments of COL Vanderpool and his assistants are mentioned in references too numerous to catalogue in this research endeavor. Moreover, the conclusions of the author in respect to the significance of COL Vanderpool's efforts would be inappropriate here. They will be found in the appropriate section of subsequent chapters. The author, however, determined the following to be particularly relevant and appropriate for inclusion at this point in the research endeavor in summation of early armed helicopter experiments.)

[12]Charles C. Griminger (LTC, USA), "The Armed Helicopter Story Part II," U.S. Army Aviation Digest, Vol 17, No. 8 (August 1971), 15.

[13]Department of the Army Vietnam Studies, "Airmobility 1961-1971," by John J. Tolson (LTG, USA), 1973, p. 6.

SKY CAV PERSONNEL, KNOWN ALSO AS
"VANDERPOOL'S FOOLS"

JAY D. VANDERPOOL
COL, USA, Ret.

# SKY CAV PLATOON - 1957

JAY D. VANDERPOOL
COL, JSA, Ret.

"THIS IS THE ORIGINAL SKY/AIR CAVALRY TEST TEAM THAT GUIDED DEVELOPMENT THROUGH THE EARLY YEARS." COL VANDERPOOL.

(Based upon personal correspondence between COL Vanderpool and the writer.)

PHOTOGRAPH TAKEN IN 1956

TOP: (LEFT TO RIGHT) CPT HAROLD HENNINGTON
COL JAY D. VANDERPOOL
CPT JAMES E. MONTGOMERY

BOTTOM: MSG QUINN
SP4 WHITNER

JAY D. VANDERPOOL
COL, USA, Ret.

KEY PERSONNEL ASSOCIATED WITH ARMAMENT EFFORTS

LEFT TO RIGHT:

LTC JOHN W. OSWALT, DEPUTY DIRECTOR, COMBAT DEVELOPMENTS OFFICE, USAAVNS

COL JOHN J. TOLSON, ASSISTANT COMMANDANT, USAAVNS

MAJ F.G. BROWN, CO, 7292 ACR CO., FORT RUCKER, ALABAMA

MG LOUIS V. HIGHTOWER, ARMY MEMBER, WEAPONS SYSTEM EVALUATION GROUP
DOD, WASHINGTON, D.C.

COL JAY D. VANDERPOOL, DIRECTOR, COMBAT DEVELOPMENTS OFFICE, USAAVNS

CPT LLOYD F. DEPPENSMITH, ORDNANCE CORPS LIAISON OFFICER, COMBAT
DEVELOPMENTS OFFICE, USAAVNS

PHOTOGRAPHED IN SEPTEMBER 1958

JAY D. VANDERPOOL
COL, USA, Ret.

Finally, the following capsulates the accomplishments of "Vanderpool's Fools,"

> 'Vanderpool's Fools' developed a great deal of spirit and worked long, hard hours to achieve their goals. Working with salvaged equipment they accomplished an almost single-handed incubation of the helicopter armament program in the U.S. Army. They had no formal research and development assistance, no designers and no evaluation personnel. The group originally worked in the post machine shop and later set up a shop of their own. Anyone in the unit who had an armament idea could have it built and tested. Many ideas were tested and several resulted in new innovations for helicopter weapons systems.
>
> In addition to weapons systems for helicopters, the men of ACR also developed tactics for employment of armed helicopters.[14]

In November 1957 a military journal described the unveiling of "the most heavily armed helicopter in the free world."[15]

> The rotor craft can fire 40 2.75-inch rockets and two five-inch rockets. In addition, the aircraft is equipped with nine machine guns and two 20-mm cannons. This marks the first time a rotor aircraft has been armed with 20-mm cannons and 5-inch rockets.
>
> The machine guns are placed both at the front and sides of the aircraft to repel attacks from all directions.[16]

The article, in addition to detailing the armament on the helicopter, contained the following statement.

> Although these weapons are currently visualized solely for defensive purposes, Army backers feel that future experiments may determine the feasibility of using them on the offense.[17]

---

[14] Griminger, p. 17.

[15] "Army Tests Heavily Armed Sky Cav Copter; 42 Rockets, 9 Machine Guns, 2 Cannons," Army Navy Air Force Journal, Vol 95, No. 9 (November 1957), 4.

[16] Ibid. [17] Ibid.

## THE AIRCRAFT AVAILABLE[18]

THE OPERATIONAL HELICOPTERS AVAILABLE FROM 1956 TO 1960 WERE PRODUCED BY FOUR AIRFRAME MANUFACTURERS IN THREE MISSION CONFIGURATIONS.

[18] ATTACK HELICOPTER THE KEY TO ARMY AIR MOBILE OPERATIONS, A Report for the Blue Ribbon Defense Panel by COL Jay D. Vanderpool, USA, Ret. (February 1970), 29.

Observation Helicopters

Bell Helicopter Company . . . . . OH-13
Hiller Aircraft Corporation . . . . . OH-23

Utility Helicopters

Sikorsky . . . . . UH-19
Vertol . . . . . UH-25

Transport Helicopters

Vertol . . . . . CH-21
Sikorsky . . . . . CH-34

## THE WEAPONS

The weapons available and tested on helicopters between 1956 and 1960 were:

### Automatic Weapons

Calibre .30 aerial machine guns
7.62 millimeter army machine guns
Calibre .50 aerial machine guns
20 millimeter aerial machine guns

### Free Rockets

1.5 inch spin-stabilized aerial rocket
2.0 inch folding-fin aerial rocket
2.75 inch folding-fin aerial rocket
8 centimeter fixed-fin aerial rocket
4.5 inch spin-stabilized artillery rocket
5.0 inch fixed-fin aerial Navy rocket

### Missiles

The French-developed Nord Aviation wire-guided missile, SS-10, was tested at Fort Rucker, while the U.S. Navy tested the Bull Pup guided missile with the CH-34.

OH-13: FIRST ARMAMENT KIT. TESTED IN JULY 1956. TWO .50 CALIBER MACHINEGUNS AND FOUR OERLIKON ROCKETS.

OH-13: ACR'S SECOND KIT: FOUR .30 CALIBER MACHINEGUNS AND FOUR OERLIKON ROCKETS

TEST FIRING OF ACR KIT (SECOND KIT) DURING HELICOPTER ARMAMENT TESTS AT USAAVNS-CIRCA 1956.

OH-13E WITH ACR KIT E; TWO .50 CALIBER
AERIAL MACHINEGUNS AND EIGHT
1.5-INCH NAKA FOLDING
FIN ROCKETS.

CLOSE-UP OF THE NAKA ROCKET KIT ON THE H-25 SHOWING THE 1.5 INCH ROCKET CHAMBERS AND A .50 CALIBER MACHINE GUN.

THE NAKA 1.5 INCH ROCKET IS FIRED FROM THE H-25.

CLOSE-UP OF THE NAKA ROCKET KIT MOUNTED ON THE UH-19, THE SAME KIT PREVIOUSLY MOUNTED ON THE H-25, CONSISTING OF THE 1.5 INCH ROCKET CHAMBERS AND A .50 CALIBER MACHINE GUN. THIS HELICOPTER WITH THIS ARMAMENT CONFIGURATION TOOK PART IN AIRMOBILITY DEMONSTRATIONS AT FORT RUCKER AND OTHER INSTALLATIONS

OH-23: ACR KIT F: SIX .30 CALIBER AERIAL MACHINEGUNS.
USED IN PRELIMINARY STUDIES OF
VULCAN-TYPE GUNS AND EFFECTS.

U.S. Army Aviation Museum

OH-13 WITH ACR KIT G: FOUR .30 CALIBER AERIAL MACHINEGUNS AND TWELVE 2.75 INCH FFAR.

OH-13: ACR KIT G: FOUR .30 CALIBER AERIAL MACHINEGUNS
AND SIX 2.75 INCH FFAR.

OH-13E: ACR KIT H, DEPICTING
INTRODUCTION OF PNEUMATIC
CHARGING MECHANISM

OH-13: ACR KIT K: FOUR SS10 GUIDED MISSILES

OH-13: ACR KIT L: TWO PODS OF TEN 89MM AERIAL ANTITANK ROCKETS ON HELICOPTER. SYSTEM EVALUATED IN SEPTEMBER 1957 AT FORT RUCKER EMPLOYING THE "WEEVIL" T-290 FIXED FIN AERIAL ROCKET DEVELOPED BY REDSTONE ARSENAL.

The .30 caliber M-37 tank mg with a 250-round ammunition drum. The AN-M2 mg was in limited supply and the M-37 could be obtained by ACR through ordnance channels.[20]

Photograph Courtesy of U.S. Army Aviation Digest

[20]Charles O. Griminger (LTC, USA), "The Armed Helicopter Story Part IV," United States Army Aviation Digest, Vol 17, No. 10 (October 1971), 22.

CH-21 WITH ACR KIT M: TWO .30 CALIBER AND
TWO .50 CALIBER MACHINEGUNS: EIGHT
OERLIKEN ROCKETS: TWO .30 CALIBER
DOOR GUNS

CH-21 WITH ACR KIT N: "THE POCKMEYER KIT."
BUILT BY POCKMEYER, INC., LOS ANGELES,
CALIFORNIA; TWO .30 CALIBER
MACHINEGUNS; TWO .50 CALIBER
MACHINEGUNS; TWO PODS, SEVEN
ROCKETS EACH, 2.75 INCH FFAR.

CH-21C WITH ACR KIT 0: B-29 GUN TURRET WITH TWIN .50 CALIBER AERIAL MACHINEGUNS ON NOSE OF AIRCRAFT. DEVFLOPED BY GENERAL ELECTRIC. EXCEEDED WEIGHT LIMITATIONS.

B-29 GUN TURRET INSTALLATION CLOSE-UP

H-21 IN FLIGHT DEPICTING B-29 GUN TURRET

CH-21 WITH ACR KIT P

U.S. Army Aviation Museum

CH-21C WITH ACR KIT Q: TWO PODS WITH SIX
TWO INCH T-214 FFAR. ACR TESTS INCLUDED
BOTH 6 AND 10 FOOT TUBES, THE
LATTER BEING 40 PERCENT
MORE ACCURATE

H-19 WITH ACR KIT R: TWO .30 CALIBER MACHINEGUNS AND
TWO 1.5 INCH NAKA ROCKET RACKS.

U.S. Army Aviation Museum

H-19 WITH ACR KIT R: FIRING.

U.S. Army Aviation Museum

H-19 WITH ACR KIT S.

H-19 WITH ACR KIT T.

U.S. Army Aviation Museum

CH-34 WITH ACR KIT U: TWO .30 CALIBER AND
TWO .50 CALIBER AERIAL MACHINEGUNS;
TWO 20MM AN-M2 MACHINEGUNS AND
TWO T-214 TWO INCH ROCKET
PODS OF SIX ROCKETS EACH

OH-13E WITH XM1E1 SYSTEM: TWO .30 CALIBER MACHINEGUNS.

OH-13 WITH XM-2 SYSTEM: TWO M-60C MACHINEGUNS.

OH-13 WITH M2 SYSTEM: TWO M-60C 7.62MM MACHINEGUNS, MOUNTED ONE ON EACH SIDE OF HELICOPTER. FIRE CONTROL EMPLOYED GREASE PENCIL MARK ON BUBBLE. PNEUMATICALLY CHARGED, ELECTRICALLY FIRED.

CH-19 WITH ARRINGTON KIT: TWO T-214 TWO INCH FFAR PODS WITH 15 ROCKETS PER POD. MR. W.F. ARRINGTON (TOP CENTER) MANUFACTURED THE TUBES AT THE FORT RUCKER MACHINE SHOP. THE TWO INCH ROCKET WAS NOT USED EXTENSIVELY BECAUSE OF ITS CORROSIVE EFFECTS AND SMOKE TRAIL.

CH-21 WITH 4.5 INCH ROCKET RACKS AND TWO
.30 CALIBER MACHINEGUNS,
NOSE WHEEL MOUNTED.

U.S. Army Aviation Museum

CH-21 WITH TWO 4.75 INCH ROCKET MOUNTS,
NOSE WHEEL MOUNTED.

U.S. Army Aviation Museum

CH-21 WITH TWO .30 CALIBER AND TWO .50 CALIBER MACHINEGUNS
AND FOUR OERLIKON ROCKETS, NOSE WHEEL MOUNTED.
OFFICER UNIDENTIFIED.

CH-21 WITH TOWNSEND GROUND FIRE SUPPRESSION KIT.
ONE .30 CALIBER MACHINEGUN.

U.S. Army Aviation Museum

CH-21C WITH TWO .30 CALIBER AND TWO
.50 CALIBER MACHINEGUNS,
NOSE WHEEL MOUNTED.

U.S. Army Aviation Museum

CH-21 WITH 4.5 INCH ROCKET RACKS. SIDE MOUNTED.

U.S. Army Aviation Museum

CH-21 WITH 4.5 INCH ROCKET RACKS, SIDEMOUNTED AND TWIN .50 CALIBER MACHINEGUNS, NOSE WHEEL MOUNTED. FRONT VIEW.

U.S. Army Aviation Museum

CLOSE-UP OF CH-34 WITH MOUNTED 20MM GUN
M-39 SYSTEM.

U.S. Army Aviation Museum

CH-34, "THE WORLD'S MOST HEAVILY ARMED HELICOPTER"

Fort Benning, Georgia, 1957

U.S. Army Aviation Museum

.50 CALIBER MACHINE GUN INSTALLATION ABOARD THE
"WORLD'S MOST HEAVILY ARMED HELICOPTER."
INSTALLED IN THE CARGO DOOR.

CH-34 WITH MARTIN BULLPUP MISSILE
CIRCA 1960

U.S. Army Aviation Museum

## ROGERS BOARD

In May 1959 the USAAVNS completed a study entitled "Development Objectives For Army Aviation 1959-1970." Accomplished at the direction of the U.S. Army Continental Army Command and Department of the Army, it included the following:[22]

1. Forecast organization of Army aviation,
2. Doctrine, and,
3. A proposed family of seven aircraft, including five piloted aircraft and two drones.

Prior to completion of the study, Department of the Army decided that "in view of long development lead time something should be started immediately on development in the more critical areas."[23] Employing the study as a point of departure, Department of the Army decided that the areas which should be given priority for development included, a new light observation aircraft, a new heavy observation aircraft designed for aerial combat surveillance and target acquisition, and a heavy tactical transport capable of operating in the forward areas without an airfield complex with its obvious runway(s).[24]

On 15 January 1960 the Army Aircraft Requirements Review Board was established by the Army Chief of Staff. Its purpose was to consider

---

[22]John W. Oswalt (LTC, USA), "Report on the 'Rogers' Board," U.S. Army Aviation Digest, Vol 7, No. 2 (February 1961), 15.

[23]Ibid. [24]Ibid.

the Army Aircraft Development Plan and to review industry proposals.[25] Also known as the Army Study Requirements Board and the Rogers Board, and chaired by LTG Gordon B. Rogers, it reviewed 119 proposals submitted by industry including all types of STOL/VTOL aircraft, powerplants and designs.[26] "Some studies defied type classification and were listed merely as unique."[27]

The conclusions of the Rogers Board were presented to and approved by the Army Chief of Staff on 19 March 1960.[28] Its recommendations included three types of aircraft--observation, surveillance, and transport.[29] Most notably, i.e., in terms of helicopter evolution, the Rogers Board recommended development be initiated on a "turbine-powered, highly reliable, 3-4 place helicopter with superior performance."[30] Other recommendations included the establishment of an aircraft replacement policy of 10 years employing technological advances or "operational requirements" as criterion.[31] Additionally, it recommended a determination be made through a detailed study, if an experimental unit should be activated to evaluate the feasibility of the concept of air fighting units.[32]

The following capsulates the significance of the Rogers Board.

---

[25]Department of the Army Vietnam Studies, "Airmobility 1961-1971," by John J. Tolson (LTG, USA), 1973, p. 8.

[26]Cswalt, p. 16. [27]Ibid. [28]Oswalt, p. 17.

[29]Ibid. [30]Ibid.

[31]Department of the Army Vietnam Studies, "Airmobility 1961-1971," by John J. Tolson (LTG, USA), 1973, p. 9.

[32]Ibid.

LTG GORDON B. ROGERS

U.S. Army Photograph

The importance of the Rogers Board has been somewhat obscured by the later Howze Board and Tests of the 11th Air Assault Division. However, it was a remarkable milestone in Army airmobility. It set forward a chain of actions which had profound effect on later concepts.

With historical hindsight, it is apparent that the scope of the 1960 Rogers Board was limited. It obviously did not constitute a major advance in tactical mobility for the Army. But, in comparison with the advances made during the 1950's, the Board's objectives, if obtained, would have represented a substantial gain in mobility through the use of aviation guidance for development, procurement, and personnel planning.

The work of the Rogers Board was symptomatic of a renaissance throughout many segments of the Army--in its schools and its fighting units.[33]

## THE HOWZE BOARD: THE SEARCH FOR MORE AIR MOBILITY[34]

The Soviets were quicker to recognize the need for large numbers of mobile ground units, and the importance not only of possessing such a mobility, but also of demonstrating it to the world.[35]

With the election of President John F. Kennedy, American reaction to the need for conventional force surfaced.[36] After conferring with President Kennedy, Secretary of Defense Robert S. McNamara requested from the U.S. Army an appraisal of the level of mobility within it. The result was significant for development of airmobility in general and for

---

[33]Ibid.

[34]John R. Galvin (LTC, USA), Air Assault (New York: Hawthorn Books, 1969), 274.

[35]Galvin, p. 275.

[36]Ibid.

the evolution of attack helicopter in particular. Secretary McNamara's response to the evaluation provided by the U.S. Army is contained in the following:

> McNamara rejected the studies as contradictory and ambivalent, and asked the Army to set up a board to examine the requirements for aircraft and the organizational changes necessary to employ them efficiently. He made it clear that he was searching for improved ground tactical performance through bold increases in mobility. He wanted a board that would report directly to the top levels of the army, and not be weakened by conservative rewriting in the layers of staff through which studies usually pass. He even named several of the army men that he wanted to see on the board, including its chairman, Lieutenant General Hamilton Howze, who at that time was commanding XVIII Airborne Corps at Fort Bragg, North Carolina.[37]

The following statement by General Howze examines and reveals the task which confronted him:

> In 1962 the Secretary of Defense initiated action which resulted in the formation of the Army's Tactical Mobility Requirements Board at Fort Bragg. At the time it didn't seem like much of an honor. Operating on a very short deadline and anxious to crowd as much philosophy, doctrine and simple fact as possible into its report, the Board gathered together an enormous and disparate quantity of people, aircraft and other equipment, subdivided itself into a large number of study groups and test units, issued everybody a double handful of tranquilizer pills, and went to work on a schedule which occupied its members about 16 hours a day throughout the summer months. Quite amazingly it made fairly methodical progress, and proceeded then to write a report which the steering committee wisely limited in size to what would fit into a standard Army footlocker. We conformed to our footlocker limitation all right, partly be referencing a lot of stuff that would not fit into it. There was a requirement however for 300 copies of the report, so that filled 300 footlockers.[38]

---

[37]Galvin, p. 276.

[38]Hamilton H. Howze (GEN, USA), Ret., "COBRA," reprinted from Verti-Flite, Vol 13, No. 9 (September 1967), 1.

LIEUTENANT GENERAL HAMILTON H. HOWZE

In still another article written by General Howze concerning matters which he identified as important both to the genesis and success of the Howze Board, the following appears:

> Army aviation was characterized by a strong dedication, particularly obvious at Fort Rucker. Because flying was informal, fun and not overly concerned with accidents, it was innovative, moved by a spirit of trial and experimentation. Its dedication was not do-or-die, but sporting and full of humor--and unbeatable.[39]

During the 90-day period which the Howze Board consumed, helicopter armament testing was conducted on a variety of helicopter and weapons combinations. All weapons testing was conducted at Fort Bragg, North Carolina. The following discussion by General Howze amplifies the testing, the purpose and the results.

> The French SS11 antitank missile was difficult to score hits with, but we knew that demonstrating a launch capability with some hits resulting was a big start, better missiles and guidance systems would surely be forthcoming, and they were. The quad 7.62mm machine guns awkwardly hung on the cross-tubes of the UH-1B's were great for that time and, of course, did splendidly in Vietnam.
>
> The same was true of the 40mm grenade launcher in a nose turret. We dropped napalm out of helicopters. We mounted Browning .50 calibers to shoot out the left rear door, also as in Vietnam, and even put a 20mm on a heavy steel plate to shoot out that door. Some of these were jury-rigged affairs, but one purpose was mostly to show that pretty formidable weapons could be used without blowing the helicopter out of the air.
>
> We recommended in our report a number of new weapons development projects and the vigorous pursuit of some already under way.[40]

---

[39]Hamilton H. Howze (GEN, USA), Ret., "The Howze Board," Army, Vol 24, No. 2 (February 1974), 11.

[40]Hamilton H. Howze (GEN, USA), Ret., "Howze Board II, Army, Vol 24, No. 3 (March 1974), 23.

Extensive employment and integration of armed helicopters was a significant aspect of the Howze Board. This point is articulated by General Howze in the following:

> Well anyway we put on some fine shows of very great violence, with extensive use of shooting helicopters going into an objective under the protection of a blanket of high explosive artillery fire. The helicopter--delivered rocket and machine gun fire protected the front and flanks of troop-carrying helicopters moving almost on their tails, and the whole effect was enormously convincing to everybody present, specifically including the troops and air crews participating.[41]

The recommendations of the Howze Board, known formally as the U.S. Army Tactical Mobility Requirements Board, were numerous and would require a consuming effort to adequately delineate in this document. However, the conclusions of the Howze Board and their perceived impact will be obvious to readers of this document from the following evaluation of GEN Tolson.

> The single major conclusion reached by the Board was terse and emphatic. "The Board has only a single, general conclusion," stated General Howze. "Adoption by the Army of the airmobile concept--however imperfectly it may be described and justified in this report--is necessary and desirable." In some respects the transition is inevitable, just as was that from animal mobility to motor.[42]

In his examination of the historical development of airmobile warfare, LTC John R. Galvin observed the following:

> The basic statement of the Howze Board report is the assertion that a wide variety of airmobile operations is feasible, including air assaults, air cavalry operations, aerial artillery support, and aerial supply lines.

---

[41] Hamilton H. Howze (GEN, USA), Ret., "COBRA", reprinted from Verti-Flite, Vol 13, No. 9 (September 1967), 3.

[42] Department of the Army Vietnam Studies, "Airmobility 1961-1971," by John J. Tolson (LTG, USA), 1973, p. 24.

## WARRIOR

The WARRIOR was a mock-up which BELL HELICOPTER put on display during the HOWZE BOARD at Fort Bragg (1962), and which was a configuration very much like subsequent helicopters designed specifically to shoot.

(Based upon personal correspondence between GEN Howze and the author.)

HAMILTON H. HOWZE
GEN, USA, Ret.

> The Howze Board was a small masterpiece, considering the limitations of time and resources.[43]

Finally, the impact of the Howze Board is addressed by General Howze himself.

> The board recommendations...called for drastic change in the Army's structure, one we fervently believed necessary to accommodate to a near-revolutionary change in land combat tactics and doctrine.[44]

## THE ROGERS BOARD AND HOWZE BOARD IN PERSPECTIVE

Writing almost a decade since the impact of the Rogers Board and Howze Board, COL Jay D. Vanderpool characterized their impact as a "revolution" generating, in his own words, "thousands of ideas and theories" regarding armed helicopters.[45] In COL Vanderpool's words,

> The revolution from the bottom spread upward in military channels. By 1960 the Army was spending R&D money on helicopter weaponry. Then in 1962 the Secretary of Defense Robert S. McNamara called for a quantum jump in Army mobility. The Army Tactical Mobility Requirements Board, under Lieutenant General Hamilton H. Howze, was convened at Fort Bragg to develop and recommend courses of action to take. The board met, studied, analyzed and tested the problems and recommended division size air cavalry forces. With the Department of Defense's blessings, money, people and equipment became available. Major General Harry W. O. Kinnard moved a cadre to Ft. Benning and organized the 11th Air Assault Division(T) for airmobility tests. Later his division became the 1st Cavalry Division (Airmobile) which he took to the Republic of Vietnam for the real test. The airmobile division proved to be an undisputed success and justified the faith that the late General Hutton had placed in armed helicopters and airmobility just 10 years earlier.[46]

---

[43]Galvin, p. 279.

[44]Hamilton H. Howze (GEN, USA), Ret., "Winding Up a Great Show Howze Board III," Army, Vol 24, No. 4 (April 1974), 24.

[45]Jay D. Vanderpool (COL, USA), Ret., "We Armed The Helicopter," U.S. Army Aviation Digest, Vol 17, No. 6 (June 1971), 29.

[46]Ibid.

To maintain the Howze Board momentum and to meet one of its major recommendations (including the feasibility of armed helicopters), Deputy Chief of Staff for Operations on 7 January 1963 issued the initial plan for the organization, training, and testing of an air assault division and an air transport brigade. Cadres of the test units were activated on 15 February at Fort Benning, Georgia. The test division was named the 11th Air Assault Division...Brigadier General Harry W.O. Kinnard had been selected to lead the 11th Air Assault Division during this critical period...(t)he Test Evaluation and Control Group, headed by (Brigadier) General (Robert R.) Williams, (would) establish a new methodology based on evaluation of the combat systems and how these systems interacted with each other.[47]

[47]Department of the Army Vietnam Studies, "Airmobility 1961-1971," by John J. Tolson (LTG, USA), Ret., 1973, p. 51-53. (Author's Note: Readers interested in more detail concerning the 11th Air Assault Division activities including its transformation into the 1st Cavalry Division with subsequent movement to Vietnam are directed to LTG Tolson's detailed treatment of same in this reference.)

COL Vanderpool traced the genesis of the Howze Board to the initial definition of the armament requirement for helicopters.[48] This armament requirement and its immediate results is characterized as follows:

> On 16 May 1960 the first qualitative material requirement (QMR) for an armed helicopter weapons system was approved, and the first systems to reach the Test Board's Armament Branch were the Townsend machinegun fire suppression kit, the SS-11 wire guided missile and the Mark XI 20MM gun in the Hughes MK IV pod.[49]

COL Vanderpool stated the significance of this specific occurrence as follows:

> Army approval of a Qualitative Military Requirement for armed helicopter weapons systems in May 1960 with a revised version in 1962 sanctioned helicopter weapons subsystems and officially justified the release of research, development and production funds. The statement of requirements was intentionally broadly defined to encourage innovative ideas to surface for recognition and evaluation.
>
> ...(T)he requirement did not define an attack helicopter but armament systems for rapid mounting and demounting on existing helicopters for employment in the attack role.[50]

The Qualitative Materiel Requirement approved by the Army for armed helicopter weapons systems "generated qualitative improvements over pre-1960 lash-ups of weapons subsystems but did not produce significant quantitative progress."[51]

---

[48] Attack Helicopters The Key to Army Air Mobile Operations, A Report for the Blue Ribbon Defense Panel by COL Jay D. Vanderpool, USA, Ret., (February 1970), 47.

[49] Charles O. Griminger (LTC, USA), "The Armed Helicopter Story Part III," U.S. Army Aviation Digest, Vol 17, No. 9, (September 1971), 10.

[50] Attack Helicopters The Key to Army Air Mobile Operations, A Report for the Blue Ribbon Defense Panel by COL Jay D. Vanderpool, USA, Ret., (February 1970), 47-48.

[51] Ibid.

There followed a series of events in Washington which would have a "profound effect on the future of airmobility."[52] Readers of this document who are interested in learning about them in detail are referred to Department of the Army Vietnam Studies, "Airmobility 1961-1971" by LTG Tolson. All of these events will not be chronicled in this treatment since taken as a whole they warrant a unique, scholarly study which would detract from this undertaking if incorporated herein.

At the nucleus of these events, however, was an "extremely critical" analytical review of the U.S. Army's aviation program.[53] When a draft of this review was provided to Secretary of Defense Robert McNamara the reaction became an Army Aviation milestone.

> On 19 April 1962 Mr. McNamara sent a now famous memorandum to the Secretary of the Army in which he stated he felt the Army's program was dangerously conservative...Mr. McNamara urged Secretary of the Army Elvis J. Stahr, Jr. to give this matter his personal attention and, in a most unusual departure from accepted procedure, suggested...individuals to manage the Army's effort.[54]

The result of Secretary McNamara's memorandum was twofold and intimately related; the one, attitudinal and the other empirical. The respective results are demonstrated in the following quotations.

> The Secretary of Defense's memorandum motivated the Army to undertake an accelerated test and evaluation program...[55]

---

[52]Department of the Army Vietnam Studies, "Airmobility 1961-1971," by John J. Tolson (LTG, USA), 1973, p. 17.

[53]Tolson, p. 18. [54]Ibid.

[55]Attack Helicopters The Key to Army Air Mobile Operations, A Report for the Blue Ribbon Defense Panel by COL Jay D. Vanderpool, USA, Ret., (February 1970), 50-51.

> Within a week after Secretary McNamara's memorandum of 19 April, Continental Army Command appointed General Howze, Commanding General of the Strategic Army Corps and of the XVIII Airborne Corps and Fort Bragg; as president of the ad hoc U.S. Army Tactical Mobility Requirements Board to conduct a reexamination of the role of Army aviation and aircraft requirements.[56]

In his examination of the growth of the airmobility concept in general and specifically the trends leading to the Howze Board, General Tolson has provided the student of military history the following stimulating insight:

> This benchmark in airmobility history resulted from the fortunate confluence of several trends: first, the personal dissatisfaction of the Secretary of Defense with the Army's failure to exploit the potential capabilities of airmobility; secondly, are undesirable attitude of many office of the Secretary of Defense civilian analysts who looked upon the service staffs and most officers as reluctantly being dragged into the twentieth century; third, there was a nucleus of Army aviation oriented officers both in the office of the Secretary of Defense Staff and Army Staff who recognized the possibility of capitalizing on Mr. McNamara's attitude to sweep aside ultraconservative resistance within the Army itself. Finally, there was an opportunity to present to the Secretary of Defense for his signature directives that would cause the Army to appoint an evaluation by individuals known for their farsightedness and to submit recommendations directly to the Secretary of Defense in order to avoid intermediate filtering.[57]

## MATURATION IN COMBAT

In mid-1961, a full decade after initial combat evaluations of helicopter employment in Korea, and less than 12 months before introduction of helicopters to Vietnam, the helicopter continued to bear a "bar sinister" reputation. Brigadier General Clifton F. vonKann, Director of Army Aviation, ODCSOPS, Department of the Army, summarized its reputation and identified its potential as follows:

---

[56]Tolson, p. 20.

[57]Tolson, p. 12.

> Unfortunately, the armed helicopter is regarded as a joke in some quarters--a throwback, if you will, to a weapons system in the category of those of World War I. However, it is not regarded as a joke to those who have flown with our air cavalry units, nor is it regarded as a "throwback" by our potential enemy. It is an obvious extension of the capability of the ground commander by providing him the same mobility for his weapons systems as he has for the troops they support. History has proved many times that a small unit cannot long survive with just its rifles and hand grenades. If the infantry is to have staying power, it must have a continuous support of heavier weapons and heavier firepower. The armed helicopter can provide this extra firepower in a responsive and effective way.[58]

Armament efforts on a turbine engine helicopter of the type generally recommended by the Rogers Board were begun by Bell Helicopter Company on the HU-1 in mid-1959. Experimental installations and tests were conducted on three basic weapons systems, the SS-10 and SS-11 wire guided missile, the XM-75 40mm grenade launcher and the M-73 7.62mm machineguns.[59] Experimental armament installations had been characterized by COL Vanderpool's blacksmithing efforts as previously discussed. The aviation engineering and ordnance community, however, were beginning to take notice.

In 1961 a Bell Helicopter Company Armament Experiment Projects Engineer expressed the helicopter armament situation to date and emerging

---

[58]Clifton F. vonKann (BG, USA), Director of Army Aviation, ODCSOPS, Department of the Army, "Tactical Employment of Helicopters," contained within "Helicopter Armament" technical papers presented at the American Helicopter Society's Fifth Annual New England Regional Clambake, August 26, 27, 1961, Burlington, Vermont, p. 5.

[59]Wesley L. Cresap, Bell Armament Experimental Projects Engineer, "Armament Experience with the HU-1 Helicopter," contained within "Helicopter Armament" Technical Papers presented at the American Helicopter Society's Fifth Annual New England Regional Clambake, August 26, 27, 1961, Burlington, Vermont, p. 10.

industry interest in an analogy which was appropriate within that milieu.

> If I may digress for a few moments, I would like to change the subject from helicopters to automobiles--from armament to air conditioners--to illustrate what I believe to be a very important point.
>
> In Texas most cars are air conditioned. The air conditioning system is either built in by the auto manufacturer or it is added later as a kit. In looking at the used car ads in Texas papers, or anywhere else in the hot southwest, you will quickly see that "Factory Air," as it is called, is much preferred to the kit installations. The reason is obvious: the factory designed and installed systems function so much better. The system is not compromised to provide adaptability to different make cars. It is integrated into the basic vehicle and makes maximum utilization of available space; the associated vehicle systems, radiator capacity, battery, etc., are all sized to accommodate the extra load requirements of the system. In the kit installation, the cooling coils and blower are hung below the dash, using much of the leg room. Since the radiator is designed to dissipate the car engine heat, and not to cool the whole car, the engine will almost always overheat when driving in city traffic. Add-on auto air conditions (sic) do work, but "Factory Air" is so much better.
>
> Now back to helicopters. An armament system created by making a kit of existing weapons and fitting them to a helicopter can undoubtedly be made to do a job. But if the weapon is designed to match with the helicopter, and the helicopter is designed, from the very beginning, to include the weapon system, then, the results will be much more effective.[60]

The significance of the armament activities preceding 1961 is addressed in the following statement of another industry representative.

> The significant fact about these installations, apart from the revolution in the mobility of tactical firepower, is that they do not represent weapon systems so much as simply the installation of already existing weapons on, and their adaption to, existing VTOL aircraft. Therefore, they represent the exploitation of existing

---

[60] Cresap, p. 11.

> equipment and technology. Though demonstrably effective, it would be purely coincidental if they came close to practicable optimums within present state-of-the-art capabilities.[61]

The Army, however, had adopted the "kit concept" which facilitated installation or removal from a helicopter in minutes.[62]

> Ideally, a universal kit would be applicable to all models of helicopters from the lightweight reconnaissance type...to larger troop and cargo ships...Furthermore, the universal kit should be capable of mounting any one or combination of weapons--machineguns, rockets, or short range missiles--depending on the tactical mission involved.[63]

The introduction of Army helicopters into Vietnam initially was not attended with the introduction of armed helicopters. Protection during flight was provided by other services employing fixed wing, close-support aircraft.[64] Although excellent close-air support could be provided helicopters enroute to an objective and on the objective itself, helicopters remained vulnerable "between the last close support pass and the time the troops...became combat effective."[65]

> Faster fixed wing aircraft could accomplish certain escort missions, and prestrike of landing zones in assault missions was accomplished up to a point. But from that point the slow flying CH-21 was left an easy target for any guerrilla smart enough to stay down in his hole and wait out the arrival of the cargo flight in the landing zone.[66]

---

[61] Ed Katzenburger, Sikorsky, Chief of the Advanced Design Branch, "History and Significance of Helicopter Armament," contained within "Helicopter Armament" Technical Papers Presented at the American Helicopter Society's Fifth Annual New England Regional Clambake, August 26 and 27, 1961, Burlington, Vermont, p. 14.

[62] Mayhood and Benis, p. 3. [63] Ibid.

[64] Attack Helicopters The Key to Army Air Mobile Operations, A Report for the Blue Ribbon Defense Panel by COL Jay D. Vanderpool, USA, Ret., (February 1970), 61.

[65] Ibid.

[66] B. A. Brown (MAJ, USA), "Armed Helicopters," U.S. Army Aviation Digest, Vol 12, No. 10 (October 1966), 15.

## UH-1B SPECIFICATIONS[67]

Utility Helicopter, entered production March 1961

| | |
|---|---|
| Power Plant: | Lycoming T53-L-5, T53-L-9 and T53-L-11 |
| Fuel Capacity: | 165 gallons |
| Standard Seating: | 9 place |
| Capacities: | Pilot, 8 troops<br>Pilot, Co-pilot, Attendant, 3 Litters<br>Internal Cargo - 140 Cubic Ft<br>External Cargo - 4000 lb limit |
| Weights: | Empty (Approximately) - 4523 lb<br>Maximum Operating - 8500 lb |
| Dimensions: | As shown on General Arrangement Drawing |

---

[67] UH-1 Reference Data, Bell Helicopter Company (January 1966), I-5.

XM-3 HELICOPTER ARMAMENT SUBSYSTEM. ENGINEERING SERVICE TEST OF UH-1B WITH XM-3 EQUIPMENT INSTALLED. PHOTOGRAPHED ON 11 JANUARY 1963.

U.S. Army Photograph

BELL UH-1B WITH M5 HELICOPTER ARMAMENT SUBSYSTEM,
CAPABLE OF FIRING 40MM HIGH-EXPLOSIVE
PROJECTILES AT A RATE IN EXCESS
OF 200 PER MINUTE.

General Electric

FRONT VIEW OF A UH-1B HELICOPTER MOUNTING THE XM-14 ARMAMENT POD, SHOWING THE M-3 AIRCRAFT MACHINEGUN COVERED. THE XM-14 POD WILL CARRY 750 ROUNDS OF AMMUNITION AND THE .50 CALIBER M-3 MACHINEGUN IS CAPABLE OF FIRING 1,300 ROUNDS PER MINUTE. MARCH 1964.

U.S. Army Photograph

XM-22 SYSTEM ON UH-1. MAXIMUM EFFECTIVE RANGE
3000 METERS ON UH-1B AND UH-1C AIRCRAFT.
TYPE CLASSIFIED IN JULY 1964. FIRST
USED IN COMBAT IN VIETNAM IN
OCTOBER 1965.

U.S. Army Aviation Museum

UH-1 HELICOPTER FIRING 2.75 INCH FFAR DURING A TRAINING EXERCISE
AT FORT RUCKER, ALABAMA, ON 24 JANUARY 1963.

U.S. Army Photograph

UH-1 WITH XM23 SYSTEM

U.S. Army Aviation Museum

UH-1 WITH M-5 SYSTEM

U.S. Army Aviation Museum

UH-1A HELICOPTER CARRYING ITS LOAD OF AIR-LAUNCHED
SS-11 MISSILES. PHOTOGRAPHED
ON 17 SEP 1960

U.S. Army Photograph

The initial remedy, a light machinegun at the door of the CH-21 proved ineffective.[69] The impact of this initial effort and other immediate remedies is contained in the following statement.

> To partially reduce vulnerability in and near the objective area, door gunners were added to the helicopter. The door gunners helped but the Vietcong were still able tofire on the soft troop ships carrying Vietnamese forces. Some of the Boeing Vertol CH-21 troop carrying helicopters were armed with rockets and machineguns with systems similar to those developed experimentally at Fort Rucker in the late 1950's. However, the additional weight and aerodynamic "drag" of the weapons degraded the CH-21 speed performance until they could not keep up with the unarmed ships in the formation.[70]

Jac Weller, previously identified and quoted, characterized helicopter armament activities in Vietnam from 1962 on as follows:

> Some of the same men who had worked stateside on arming helicopters were in responsible positions in Vietnam. They continued their experiments, but had the benefit of the experience already gained and some special "semi-standardized" ordnance material, mainly simple MG- and rocket-mounting systems.
>
> MGs and rockets were hung on "Shawnees," (CH-21s), "Choctaws" (CH-34s), and "Hueys" (UH-1s). All these were primarily transports. Some arms were secured to the smaller plexiglass bubble observation aircraft, the "Sioux" (OH-13) and "Raven" (OH-23). But only one weapons system was sufficiently standardized to be procurred commercially. It consisted of two MG's attached to brackets on the landing skid cross tubes; 600 units were purchased through the middle of 1965.[71]

---

[69] Tolson, p. 29.

[70] Attack Helicopters The Key to Army Air Mobile Operations, A Report for the Blue Ribbon Defense Panel by COL Jay D. Vanderpool, USA, Ret., (February 1970), 61.

[71] Weller, p. 3.

The next step was the introduction of armed helicopters into Vietnam. That this occurrence took place is apparent historically. The specific reason is not as apparent as evidenced by the different reasons expressed in the following explanations:

> Early attempts had been made to arm the CH-21 with a light machinegun at the door, but this fire was relatively ineffective. To better meet this requirement, the Army formed the Utility Tactical Transport Company and deployed it to Vietnam in 1962.[72]

> Due to increasing combat damage to CH-21s in Vietnam, in October 1962 the UTT was assigned to Vietnam to provide armed escort for the CH-21s.[73]

> The intimate close fire power support requirement led to the activation of the first Army armed helicopter unit (other than experimental units) designed to provide close, intimate and continuing fire support during all phases of air mobile operations.[74]

> The first armed helicopter unit organized and assigned the mission of escorting cargo helicopters in Vietnam was the Utility Tactical Transport Helicopter Company which was moved to Vietnam in 1962.[75]

Initially the UTT was equipped with UH-1A helicopters armed with locally fabricated weapons.[76] "They were nonflexing (M-60 machineguns) and mounted on the side of the aircraft."[77] "By late 1962 the UH-1A was replaced by the UH-1B armed with XM-6 quad machineguns and 16 "jury-rigged" 2.75 inch aerial rockets."[78] By the time these UH-1B helicopters arrived in Vietnam they had been equipped with "factory installed weapons systems of four M-60 machineguns per aircraft."[79]

---

[72]Tolson, p. 29. [73]Lockwood, p. 34. [74]Vanderpool, pp. 61-62.

[75]Brown, p. 15. [76]Tolson, p. 30. [77]Lockwood, p. 34.

[78]Brown, p. 15. [79]Tolson, p. 30.

Service fabrication of helicopter weapons systems continued after the arrival of the UTT in Vietnam and continued even after the "factory installed weapons systems" began arriving. The concept of local fabrication was not unique to the U.S. Army. The U.S. Marine Corps fabricated weapons systems initially for its Vietnam employed helicopters.[80] These weapon systems were fabricated in kit form and since they used M60-C machineguns and 2.75 inch rockets they resembled similar U.S. Army kit fabrications.[81] The U.S. Navy, on the other hand, borrowed UH-1B helicopters from the Army initially to inaugurate armed helicopter employment in support of naval operations in Vietnam.[82]

The increasing need for additional firepower prompted the birth of the armed helicopter and the development of weapon systems in the form of kits.[83]

---

[80] D.K. Tooker (LTC, USMC), "Armed Helicopters," Marine Corps Gazette, Vol 50, No. 5 (May 1966), 45.

[81] Erwin J. Bulban, "Navy Using Armed Helicopters in Vietnam," Aviation Week and Space Technology, Vol 88, No. 21 (May 1968), 71. (Readers interested in more detail concerning Navy armed helicopters in Vietnam in narrative and pictorial form are encouraged to reference the following document: "Navy Gunship Helicopters in the MeKong," U.S. Naval Institute Proceedings, Vol 95, No. 5 (May 1968), pp. 91-104.)

[82] William J. Durrenberger (COL, USA), "New Teeth For Copters in Vietnam," The Journal of the Armed Forces, Vol 102, No. 52 (August 1965),2.

[83] Mr. Jac Weller, recognized authority on weapons and tactics provided an appraisal of selected helicopters and weapon systems employed in Vietnam in his article (previously referenced) "Gunships Key to a New Kind of War." (Author's Note: A photographic synopsis of the weapon systems developed during the initial and middle stages of the Vietnam conflict are included for interested readers in Appendix B. This author does not purport to have included all weapon systems of the Vietnam era since these systems both in locally fabricated form, and in factory installed form are too numerous to catalogue in any document which does not have this specific purpose.)

## THE BIRTH OF THE HUEY COBRA[84]

The emphasis in 1962 and 1963 in arming helicopters was on locally fabricated or factory installed weapon systems on helicopters with proven dynamic components.[85] Gradually, however, technological advances in other helicopters and systems began to identify the importance of an aircraft specifically designed as an attack helicopter.

> The Army had long realized that the Huey-gun-rocket combination was a make-shift, albeit, quite ingenious, system that should be replaced by a new aircraft specifically designed for the armed mission. In the early 1960's, industry asserted that advance was within the state-of-the-art.[86]

The specific technological advances which necessitated the development of an armed helicopter are identified in the following statement.

> The Bell utility aircraft UH-1B, with machineguns and rockets, was the primary armed helicopter. The weight and drag of the weapons packages reduced speed capabilities of the UH-1B from 100-110 knots to 80-85 knots, but it was considered adequate for escorting Vertol CH-21 transports.
>
> The introduction of the Bell UH-1D rotary-wing utility vehicle with an air speed of 110 knots and the Vertol CH-47 transport helicopter with an air speed of 130 knots produced an unfavorable speed differential. As the armed UH-1B escort could not match the air speed available to the troop transports, the troop ships either reduced speed or outran their gunships. As in naval surface maneuvers, escorting vehicles should have a speed in excess of escorted vehicles. A favorable speed differential enables the escort freedom to maneuver, attack enemy threats and rejoin the

---

[84] Hamilton H. Howze (GEN, USA), Ret., "COBRA," reprinted from Verti-Flite, Vol 13, No. 9, (September 1967), 3.

[85] Vanderpool, p. 62.

[86] Tolson, p. 146.

column without degrading the transport mission. The air speed capabilities of the transport versus the escort were the reverse of the normally desired characteristics.[87]

Decisions which followed resulted in the U.S. Army receiving a helicopter referred to as the "World's First Attack Helicopter."[88]

General Howze provided additional background information concerning the genesis of the new armed helicopter in his statement:

> The Army of course couldn't and didn't ask Bell to proceed with the development of Warrior. However, some of Bell management went to Vietnam in 1964 and could see there some limitations of the ordinary Huey UH-1B, which after all wasn't designed to shoot, in the execution of its battle missions. In fairness to the crews which have fought them so effectively I must make plain that the Huey gunships have done Yeoman service in Vietnam...
>
> Bell made the decision in March 1965 to build as a company project the first flying prototype of a helicopter designed specifically to shoot. Because UH-1B components were extensively applicable, the first Cobra was constructed and flown within six months of the decision.[89]

General Tolson capsulated the apparent advantages which the Cobra offered.

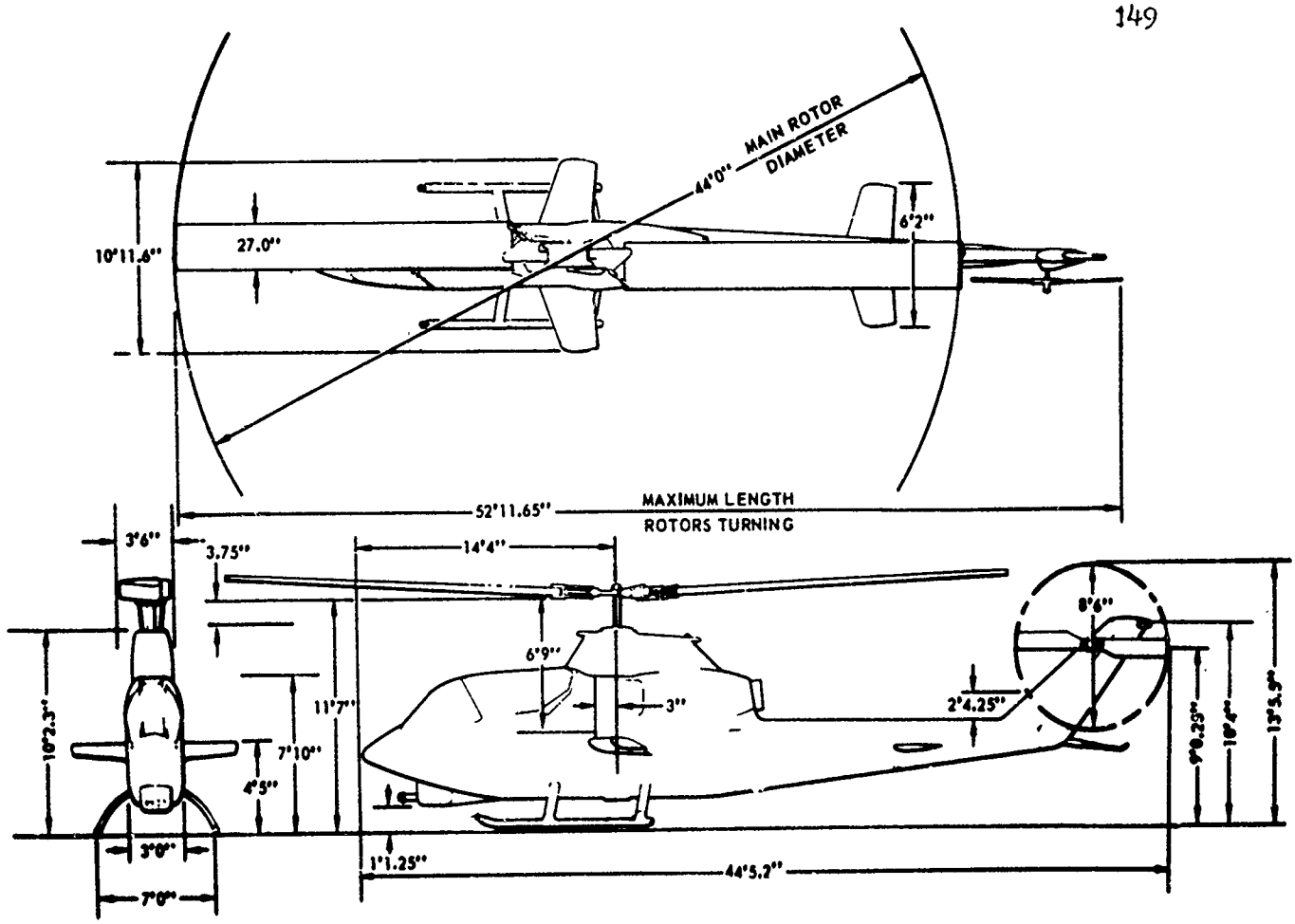
> Bell Helicopter Company had prudently carried on its own research and development program using proven dynamic components of the Huey. Consequently, they were able to offer, at the appropriate moment, an "off-the-shelf" armed helicopter for just slightly more than the modified UH-1 that the Army was then buying to replace Vietnam attrition. The "Cobra" had enough speed to meet the escort mission; tandem seating; better armor; and a better weapons system. With the strong urging of the combat commanders, the Army decided to procure an "interim" system for immediate requirements while it sorted out the problems of the "ultimate" system.[90]

---

[87]Vanderpool, pp. 65-66. [88]Howze, p. 1. [89]Howze, pp. 3-4.

[90]Tolson, pp. 146-147.

SIOUX SCOUT: BELL HELICOPTER. THIS HELICOPTER WAS A PROTOTYPE DESIGNED AND DEMONSTRATED BY THE BELL HELICOPTER COMPANY DURING THE EARLY 1960'S TO ESTABLISH SOME OF THE CONCEPTS REQUIRED OF AN ARMED AERIAL FIRE SUPPORT SYSTEM. IT FEATURED A NARROW, STREAMLINED FUSELAGE TO PROVIDE MINIMUM DRAG, AND TANDEM SEATING FOR THE PILOT AND GUNNER PROVIDING MAXIMUM VISIBILITY. FIRST FLIGHT: JUNE 1963.




# U. S. Army Huey Cobra

THREE-VIEW DRAWING

## SPECIFICATIONS

| | |
|---|---|
| MODEL | 209 |
| MILITARY DESIGNATION | AH-1G (Army) |
| PRIMARY MISSION | Armed Tactical Helicopter |
| NUMBER OF SEATS | 2 |
| ENGINE | |
| Manufacturer | Lycoming |
| Model | T53-L-13 |
| Horsepower | 1400 |
| AIRCRAFT | |
| Empty weight (lbs) | 5510* |
| Normal gross weight (lbs) | 9500 |
| Maximum speed (mph) | 219 |
| Cruise speed (mph) | 168 |
| Normal fuel capacity (gals) | 270 |

| | |
|---|---|
| AIRFRAME | |
| Fuselage length (ft) | 44' 5.2" |
| Overall length (ft) | 52' 11" |
| Overall width (ft) | 36" |
| Overall height (ft) | 11' 7" |
| ROTOR SYSTEMS | |
| Main rotor diameter (ft) | 44' |
| Number of blades | 2 |
| Tail rotor diameter (ft) | 8' 6" |
| Number of blades | 2 |

*Includes armor, chin turret and sighting system.

(Author's Note: Howze, Hamilton H. (GEN, USA), Ret., "COBRA" Verti-Flite, Vol 13, No. 9, (September 1967), 9.)

COMPARISON PHOTOGRAPH DEPICTING SLEEK SILHOUETTE
OF BELL COBRA (CENTER) BETWEEN TWO OTHER
BELL MODELS, OH-13S, LEFT
AND UH-1B, RIGHT.

Bell Helicopter

AH-1G TOW-COBRA IN FLIGHT, EQUIPPED WITH TOW MISSILES

Bell Helicopter

The following comments of COL Vanderpool address the specific reasons for selection of the Cobra.

> The Army Staff and Headquarters Army Materiel Command reviewed candidate vehicles from two viewpoints specifically operational characteristics and logistical considerations. Aircraft considered were the Vertol CH-47A, the Sikorsky S-61, the Kaman UH-2, the Plasicki 16H-1B, and the Bell Huey Cobra. From an operational characteristics analysis, the Sikorsky S-61 appeared best in the field. From a logistic perspective, the Bell Huey Cobra was the most attractive.
>
> The Bell Huey Cobra, although a Tandam cockpit gunship, employed proven aerodynamic and structural components which were already in the Army inventory. Additionally, the Huey Cobra employed the Lycoming T53-L-13 engine which was an outgrowth of the Lycoming family of engines long tested in the UH-1 family of utility helicopters. Over ninety percent of required repair parts were common items in the Army maintenance inventory. Existing tools and test equipment were compatible with the Huey Cobra.[92]

With deliveries of the aircraft scheduled to begin in January, 1969, the U.S. Army now possessed an armed helicopter which "could get to the combat area more quickly than UH-1D troop-carrying helicopters and a little sooner than the Chinook troop transport."[93] The intended employment of the Cobra is described in the following statement:

> Designed specifically for armed helicopter missions, it will be used primarily to escort aerial operations and prepare landing zones, for aerial search and destroy missions and general support of ground operations.[94]

---

[92]Vanderpool, pp. 66-67.

[93]"Huey-Cobra," U.S. Army Aviation Digest, Vol 12, No. 5 (May 1966), 14.

[94]"Cobra, Newest in the Huey Line," Rotor and Wing, Vol 1, No. 6 (November 1967), 23.

The timeframe within which the helicopter was produced and provided to the U.S. Army is worthy of consideration as an example of the ability of industry to accomplish such a technological advance.

> The go-ahead to build the Huey-Cobra was given by Bell management in March 1965. The ship rolled off the line September 4 and three days later made its first flight.
>
> In December 1965 the Huey-Cobra was taken to Edwards Air Force Base where it was evaluated by TECOM in competition with other manufacturers. By March 1966, the Army had announced it would order the Huey-Cobra.[95]

The approach which Bell engineers took in design and engineering efforts were innovative and a radical departure from the previous approach of affixing locally fabricated or factory installed weapon systems kits to already existent helicopters.

> Engineers at Bell designed the ship on this premise: that a weapons support helicopter should deliver the highest armament payload possible in the most effective yet least vulnerable manner. Thus, attention was centered on providing the aircraft with good maneuverability, increased payload and effective delivery, and the crew with field of view compatible with field of fire and minimum vulnerability.[96]

A milestone in U.S. Army aviation was reached with the introduction of the Cobra. Not only was it specifically designed as an armed

---

[95]"Cobra, Newest in the Huey Line," Rotor and Wing, Vol 1, No. 6 (November 1967), 28.

[96]Ibid. (Author's Note: The previous two references provide interested readers with a concise, yet detailed explanation of the Cobra's engine, armament systems, crew protection, employment potential, and interface between Bell representatives and Army aviation specialists known as the Huey Cobra New Equipment Training Team which introduced the Cobra to Vietnam. Both articles are coupled with pictorial documentation and examined jointly can provide a wealth of general and specific technical data.)

helicopter, but it was the first armed helicopter introduced which satisfied a fifteen year old user requirement, stated, interestingly during the Korean War.

> Pilots from the combat area have not been hesitant in submitting their suggestions for improvements. For any future helicopter performing the missions encountered thus far, a maximum speed of at least 125 knots is considered mandatory with a diving speed, to facilitate evasive action, of at least 170 knots. Instrumentation lighting, self-sealing tanks, metal rotary blades, and armor protection are considered necessary components for all new models.[97]

---

[97] Edward L. Barker (LT, USN), "The Helicopter in Combat," U.S. Naval Institute Proceedings, Vol 77, No. 11 (November 1951), 1213.

# CHAPTER IV

## ADVANCED AERIAL FIRE SUPPORT SYSTEM

The following discussion of the AAFSS by this author is simultaneously a termination and a beginning. It terminates research into the evolution of the armed helicopter by advancing the reader into the realm of current events, thereby completing this particular treatment. However, more significantly, AAFSS and its progeny, the AAH, represent a beginning, a departure point for a "new generation of major combat weapons for the 1980's and beyond."[1]

The significance of the AAH in the U.S. Army's view and its relationship to the "new generation" is capsulated in the following statement.

> The Army still places most of its hopes for future battlefield superiority in five key development programs: an advanced attack helicopter (AAH), a new main battle tank (XM1), a mechanized infantry combat vehicle (MICV), a modern utility and transport helicopter (UTTAS) and a versatile, highly sophisticated air defense system, (SAM-D).
>
> The Army has asked Congress for full scale development funding for all of these, amounting to about one-fifth of the service's proposed R&D budget for fiscal 1975.[2]

The importance of these weapons systems was concisely stated by the U.S. Army Chief of Staff in March 1973 in an appearance before the Subcommittee on Defense, United States Senate.

---

[1]Eric C. Ludvigsen, "Army Weapons and Equipment, 1974: Concentrating on the Essentials," Army, Vol 24, No. 10 (October 1974), 131.

[2]Ibid.

> The weapons systems which I will now discuss are referred to as the "Big Five." They represent a family of weapons essential to our success on the battlefield of the 1980's...The "Big Five" are the most important of todays weapons developments for tomorrow's Army.[3]

Coincidently General Abrams made his pronouncement concerning the AAH almost a decade to the day after Cyrus B. Vance, then Secretary of the Army, officially signalled the beginning of the AAFSS in his statement: "We must now press forward with speed and imagination to develop a more advanced weapons system which will more nearly approximate the optimum."[4]

The impetus and significance of Secretary Vance's memorandum on the AAFSS was evaluated as follows.

> The decision of the Secretary of the Army initiated a systematic development program designed to provide a revolutionary attack helicopter by 1970. The conceptual vehicle was entitled the "Advanced Aerial Fire Support System." The official designation was AH-56A. The development process was scheduled to follow classic procedures of preliminary design, concept formulation, contract definition, engineering development, and operational systems development.[5]

On 2 November 1965 Army RDT&E funds were released by the Director, Defense Research and Engineering. Twenty-four hours later

---

[3]Statement of General Creighton W. Abrams, Chief of Staff, U.S. Army, Before the Subcommittee on Defense, United States Senate, First Session, 93d Congress, 29 March 1973, p. 15.

[4]Memorandum, Cyrus B. Vance, Secretary of the Army, Washington, D.C., Subject: High Speed Helicopter Weapons System, to the Chief of Staff, U.S. Army, Washington, D.C., 27 March 1963.

[5]Vanderpool, p. 64. (Additional background information specifically on the genesis of AAFSS, too lengthy to quote and include at this point in development, is included for interested readers in Appendix B.)

Lockheed was announced as the winner and was awarded a contract to "design, develop and test ten prototype aircraft."[6] Thus, the genesis of the "new generation" attack helicopter is revealed first, in the action and Secretary of the Army Vance on 27 March 1963, and, second, in the contract award to Lockheed on 3 November 1965. Stage I of the U.S. Army's program to develop a "new generation" attack helicopter had begun. It was to continue until 9 August 1972 "when the Army killed the Cheyenne."[7]

Stage II began on 10 November 1972 when the AAH project was "rekindled by Kenneth Rush, the Deputy Secretary of Defense, in approving release of Requests for Proposal (RFP) to industry."[8] Stage II continues even as this research is being accomplished.

To establish the framework within which the AH-56A began to take shape the following basic information is significant.

> The AH-56A (was) the first major Army weapons system to undergo the Department of Defense development cycle, which include(d) contract definition (Phase I), Engineering development (Phase II), and Production (Phase III).[9]

---

[6]Vanderpool, p. 65.

[7]William J. Maddox, Jr. (BG, USA), "A Key To Army Airmobility: The Advanced Attack Helicopter," Army Aviation Vol 21, No. 12 (December 1972), 9.

[8]Ibid. (Author's Note: As stated in Chapter I early in the research effort the author determined the desirability of proceding chronologically. Therefore, the discussion which follows commences with Stage I of the attack helicopter development program.)

[9]E.S. Cruz, Department Manager, Helicopter New Design, Lockheed-California Company, "The AH-56A "Cheyenne"-U.S. Army's Newest Warrior," Verti-Flite, Vol 13, No. 8 (August 1967), 2.

As previously mentioned the first milestone and major impetus to the AAFSS program was provided by Secretary of the Army, Cyrus B. Vance, in March 1963. Eleven months later another important stimulus was provided as reported in the following.

> In February 1964, General Earle G. Wheeler, then Army Chief of Staff, told a subcommittee of the House Appropriations Committee: "We are ready for the big jump." General Wheeler went on to explain: "We want a true weapons helicopter, one that is built for the purpose and is not merely a conversion from other type helicopters.[10]

The U.S. Army took action in accordance with existing procurement regulations thereby beginning the process as evidenced by the following.

> Procurement of the AH-56A weapon system ha(d) been conducted within the framework of DoD Directive 3200.9 and was initiated by the U.S. Army Material (sic) Command in August 1964 leading to the contract definition phase from March to September of 1965.[11]

Further amplification of the first phase is contained within the following.

> The U.S. Army awarded PDP (Program Definition Phase) contracts in March 1965 for the AH-56A vehicle to Lockheed Aircraft Corporation

---

[10] Emil E. Kluever (LTC, USA), "Cheyenne!" Army Digest, Vol 22, No. 9 (September 1967), 9.

[11] P. W. Theriault, Chief Rotary Wing Design Engineer, Lockheed-California Company, "Status Report on Design Development of the AH-56A Cheyenne," 24th Annual National Forum Proceedings, American Helicopter Society, Sheraton Park Hotel, Washington, D.C., May 8, 9, 10, 1968, p. 1.

and the Sikorsky Aircraft Company, which were completed and formally presented at Ft Eustis, Va, on August 11, 1965.[12]

The Program or Contract Definition Phase was a dynamic period in the evolution process as indicated by the following:

> To meet the requirements of the weapons system, a long series of design trade-offs were made during the contract definition phase to select the final configuration for the design of the subsystems. Alternate systems were evaluated to determine the effect on weight, cost, vulnerability, maintainability, reliability and producibility in order to select the optimum system to be used in the aerial vehicle.[13]

Subsequently Lockheed was awarded a hardware development contract for "10 each AH-56A compound rigid rotor 'Weapon System' vehicles."[14] Thus the Engineering Development phase was entered. Contrary to COL Vanderpool's reported date of 3 November 1965, the date was in March, 1966.[15] On 3 May 1967 Lockheed officially presented the first of ten prototype AAFSS ahead of schedule, "a little more than three years after General Wheeler's forecast of a 'big jump.'"[16]

The following information, presented from a variety of sources, is arranged to facilitate understanding of AAFSS as originally conceived. The AH-56A Cheyenne was the "first rotary wing vehicle developed specifically as in integrated weapons system."[17]

---

[12] George W. Hagelin, AAFSS Technical Systems Manager and Thomas W. Hancock, Group Engineer, AH-56A Avionics Project, "AAFSS(AH-56A) Application of a Fully Integrated Avionics Aircraft Weapons System," 23d Annual National Forum Proceedings, American Helicopter Society, Sheraton Park Hotel, Washington, D.C., May 1967, p. 2.

[13] Cruz, p. 2-3. [14] Hogelin and Hancock, p. 2.

[15] Kluever, p. 9 and Cruz, p. 5. [16] Kluever, p. 9.

[17] Cruz, p. 2.

## CHEYENNE SPECIFICATION SUMMARY[18]

Service Ceiling: 26,000 ft.

Hover Ceiling: 10,600 ft.

Acceleration: 0 to 230 mph in 38 sec.

Deceleration: 230 mph to 0 in 17 sec.

Pusher propeller supplies forward speed. Level flight 250 mph max; 240 mph cruise; max rate of climb: 3,420 ft/min.

Endurance: 5.4 hr.

Range: 874 miles

Ferry Mission Range: 2,886 miles

Weaponry capability includes grenade launcher, machine guns on turrets, rockets and antitank missiles; fired by 2 man crew.

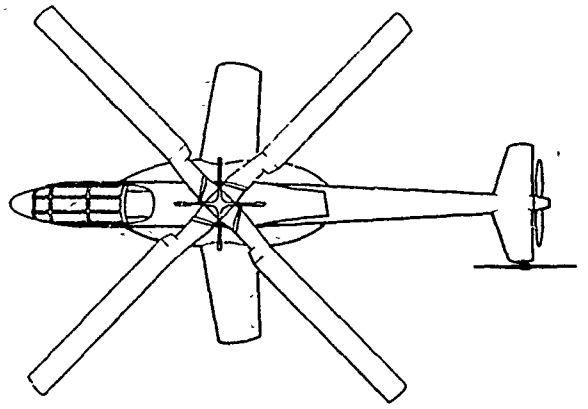
Rearming Time: 10 minutes

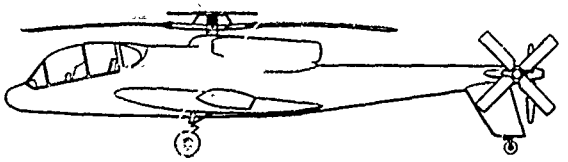
Reconfiguration Time: 10 minutes

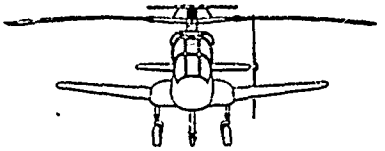
Computer-directed fire control system utilizes laser beam range finder, highly magnified stabilized sighting.

---

[18] Army Aviation, Vol 17, No. 1 (January 1968), 10-11.







GENERAL ARRANGEMENT DRAWING

AH-56A CHEYENNE SPECIFICATIONS[19]

| | |
|---|---|
| Length | 54.7 ft. |
| Height | 13.7 ft. |
| Main Rotor Diameter | 50.4 ft. |
| Tail Rotor & Pusher Prop. Dia. | 10.0 ft. |
| Wing Span | 26.7 ft. |
| Empty Weight | 12,250 lb. |
| Mission Design Gross Wt. | 18,300 lb. |
| Engine | General Electric 3435 Shaft HP T64-GE-16 Gas Turbine |

---

19 E. S. Cruz, Department Manager, Helicopter New Design, Lockheed-California Company, "The AH-56A 'Cheyenne' - U.S. Army's Newest Warrior," Verti-Flite, Vol 13, No. 8 (August 1967), 3.

LOCKHEED AH-56A CHEYENNE - FRONT VIEW.
PHOTOGRAPHED ON 3 MAY 1967 ROLLOUT
AT THE LOCKHEED-CALIFORNIA,
VAN NUYS PLANT

U.S. Army Photograph

# EARLY AAFSS CANDIDATES AND TEST VEHICLES FOR COMPOUND HELICOPTER TECHNOLOGY

Army Aviation

# KAMAN UH-2 SPECIFICATION SUMMARY[20]

A compound version of the utility helicopter. Kaman Aircraft Corporation, Bloomfield, Connecticut.

## Engines

One GE T58-8 turbine engine of 1,250 shp (shaft horse power) and one GEJ-85 Turbojet of 2,500 lb/thrust for auxiliary propulsion.

## Rotor System

Single four-bladed main rotor. Three-bladed tail rotor, 9 ft. 4 in. diameter.

## Specifications

Rotor diameter: 44 ft. Length: 52 ft. 6 in. Height: 13 ft. 7 in. Empty weight: 6,100 lb. Gross weight: 8,637 lb.

## Performance

Max(imum) speed (SL)(sea level): In excess of 225 mph. No other performance figures available.

## Remarks

The UH-2 Compound Seasprite was flown in 1965 under a joint Army/Navy test program to investigate the high speed potential of the Seasprite rotor system. The UH-2 compound is basically a UH-2 with stub wings and an auxiliary jet engine added.

---

[20]"UH-2", Army Aviation, Vol 18, No. 8 (August 1969), 81.

## BELL YUH-1B SPECIFICATIONS SUMMARY[21]

Research compound helicopter. Bell Helicopter Company, Fort Worth, Texas.

### Engines

One Lycoming T53-L-11 turbine engine of 1,100 shp and two J69-T27 turbojet engines of 1,260 lb/thrust each.

### Rotor System

Single two-bladed main rotor with tapered blade tips. Two-bladed tail rotor.

### Specifications

The aircraft is basically the UH-1B with modifications for mounting the two turbojet engines, two stub wings, and the addition of fairings around the mast and cross tubes. Rotor diameter: 44 ft. Overall length: 53 ft. Fuselage length: 42 ft. 7 in. Height: 12 ft. 8 in.

### Performance

The YUH-1B has been flown in excess of 250 mph in level flight. No other performance data available.

### Remarks

The YUH-1B was developed under a joint program by Bell Helicopter Company and the U.S. Army Transportation Research Command (TRECOM).

---

[21] "YUH-1B", Army Aviation, Vol 18, No. 8 (August 1969), 82.

# LOCKHEED XH-51A SPECIFICATION SUMMARY[22]

Two-place research compound helicopter. Lockheed-California Company, Burbank, California.

## Engines

One United Aircraft of Canada PT-6B-6 turbine of 500 shp, and one Pratt & Whitney JT-12A turbojet.

## Rotor System

Single four-bladed Lockheed rigid rotor system. Two-bladed tail rotor, 6.5 ft. diameter.

## Specifications

Rotor diameter: 35 ft. Fuselage length: 32 ft. 4 in. Height: 8 ft. 2 in. Wing span: 16 ft. 10.5 in. Empty weight: 3,500 lb. Gross weight: 4,700 lb.

## Performance

Max(imum) speed (SL): 272 mph. Cruise speed SL): 230 mph. Service ceiling: 20,000 ft. Hover ceiling (OGE) (out of ground effect): 2,500 ft. Range: 270 st(atute) mi(les). Endurance: 4 hrs. Rate of climb: 3,500 fpm (feet per minute).

## Remarks

This compound helicopter is basically an XH-51A with stub wings and a jet engine added. The aircraft was developed under an Army-sponsored program.

---

[22]"XH-51A", Army Aviation, Vol 18, No. 8 (August 1969), 82.

## PIASECKI 16H-1C SPECIFICATION SUMMARY[23]

Eight place developmental shaft compound, ring-tail helicopter. Piasecki Aircraft Corporation, Phila(delphia), Pennsylvania.

### Engines

One GE T-58-5 turbine engine, 1,500 shp.

### Rotor System

Fully articulated 3-bladed main rotor and a 3-bladed controllable pitch ducted tail-prop(eller) for forward propulsion and anti-torque directional control.

### Specifications

Rotor diameter: 44 ft. Empty Weight: 4,800 lbs. STOL (Short Takeoff and Landing) Weight: 8,150 lbs. Disc loading: 5.36 lb/sq ft. STOL Gross Weight: 10,800 lbs.

### Performance

Max(imum) speed (SL): 207 mph, cruise speed (SL) 187 mph @80% takeoff power, service ceiling: 18,700 ft. Hover ceiling: (OGE) 7,800 ft. Max. range: 450.

### Remarks

Private development initially by Pi AC as 16H-1 Pathfinder, it was later modified to the Pathfinder II under a joint Army-Navy contract to explore high speed.

---

[23]"16H-1C", Army Aviation, Vol 18, No. 8 (August 1969), 71.

LOCKHEED AH-56A CHEYENNE PHOTOGRAPHED ON FIRST FLIGHT,
21 SEPTEMBER 1967.

Army News Photo Features

The basic requirements for the AAFSS which were identified during the contract definition phase "formed the basis for design of the AH-56A CHEYENNE."[24] Availability, reliability, maintainability, logistics support and training were among the included system considerations.[25]

## WEAPON SYSTEM REQUIREMENTS

Specific weapon system requirements were classified (and remain so), however, the following statement by Lockheed engineers is indicative of the relationship of weapon system requirements to what was then state of the art.

> The speed, payload capacity, navigation and weapons delivery accuracy represent a large step forward in the state of the art of armed compound helicopters over anything available in the free world arsenal of weapons.[26]

Engineers Klivans and Baskind described the weapon system requirements thus.

> In terms of utilizing the Cheyenne to accomplish its intended weapon system function, the key system requirements may be defined in simple, qualitative terms as follows.
>
> 1. Rapid and Accurate Delivery of Internal/External Payload.
>
> 2. Transportation of Large and Varied Payload to Engagement Area.
>
> 3. High Mission Availability (Reduced Maintenance and Increased Reliability).

---

[24]Theriault, p. 1. [25]Ibid.

[26]Larry S. Klivans, Assistant Chief Engineer, and David Baskind, Assistant Chief Engineer, Rotary Wing Systems, Lockheed, "A-V-I-A-R-M-F-I-C-S AVIonics-ARMament-FIre Control System for the Cheyenne Weapon System," 25th Annual National Forum Proceedings, American Helicopter Society, Sheraton-Park Hotel, Washington, D.C., May 14, 15, 16, 1969, p. 1.

4. Pre-Strike Surveillance, and Post-Strike Assessment.[27]

The weapon system requirements in turn resulted in "an integrated weapon system with particular attention paid to capitalizing on multipurpose subsystems."[28] A description of the subsystems is contained in the following.

There are five major subsystems...

1. Aerial Vehicle
2. Fire Control
3. Armament
4. Navigation and Communication
5. Ground Support Equipment.[29]

The following information highlights the first four of the major subsystems to provide the reader with additional insight into AAFSS.

## AERIAL VEHICLE

The weapon system's most basic component consists of a two-place compound helicopter.[30] The significance of this is explained thus.

> This means that its rigid rotor and conventional tail rotor give it all the capabilities of a conventional helicopter-but at higher speeds (above 100 knots) it takes on the handling characteristics of a fixed-wing aircraft. The rigid rotor enhances maneuverability providing an added margin of safety.[31]

---

[27]Ibid. [28]Theriault, p. 1. [29]Ibid.

[30]Cruz, p. 2. [31]Kluever, p. 9.

A wing and pusher propeller permit the rotor to be substantially unloaded at high speed.[32]

At higher speeds the results are: reduced mission cost; reduced blade stresses, lower maintenance cost, less cabin vibration and maintenance of weapons accuracy.[33] Specific aerial vehicle description and performance data are contained in the separate tabulation page.

Two specifically non-technical facts which are significant are contained in the following. The first element of significance is relative size.

> The AH-56A is not a large vehicle, as may be seen by a comparison with the UH-1D "Huey." The rotor diameter is essentially the same, resulting in aft fuselages of approximately equal length. The major difference in fuselage length between the two vehicles is in the length of the forward fuselage. The "Cheyenne" extends farther forward due to the tandem seating arrangement of the pilot and co-pilot/gunner. One basic dimensional difference due primarily to the installation of a rigid rotor on the AH-56A, is the lesser height of the AH-56A from the bottom of the fuselage to the top of the mast.[34]

The second element of interest is ferry range. "On a ferry (minus payload) mission, the AH-56A is designed for a 2900-mile (statute) range. It can cross the United States non-stop, fly the Pacific with refueling stops at Hawaii, Wake Island, and Guam."[35]

Most concisely stated, "the lift capability of the pylons allows

---

[32] J. F. Johnston and J. R. Cook, Rotary Wing Systems Engineering-Airframe, Lockheed, "AH-56A Vehicle Development." 27th Annual National V/STOL Forum, American Helicopter Society, Washington, D.C., May 1971, p. 1.

[33] Cruz, p. 6. [34] Cruz, p. 3. [35] Kluever, p. 9.

sufficient fuel for over 2500 miles ferry range. Thus the Cheyenne is self-deployable anywhere in the world."[36]

## FIRE CONTROL

System description, complexity and potential for computer assisted accuracy is contained within the following.

> The gunner's periscope sight (or open sight) provides azimuth and elevative information to the central computer. The laser range finder in the periscopic sight provides updated range information, the doppler radar provides ground speed, and the inertial platform provides heading and attitude reference data. The central computer combines this data with the stored ballistic information on the particular weapon selected and computes and aims the weapon for maximum accuracy.[37]

> The pilot also will be able to fire the weapon. He will be equipped with a Honeywell developed helmet sight that will automatically aim the weapon on turrets wherever he looks.[38]

One author referred to fire control apparatus thus:

"It all sounds much like Buck-Rogers type plans actually realized."[39] An important aspect of fire control, specifically target acquisition, is dependent upon the innovative swiveling gunner's station, a description of which is contained herein.

> The copilot/gunner's seat turns a full 360 degrees (Actually 200 degrees in either direction from straight ahead). As a result, he doesn't have to turn in his seat, but just keeps his eye on the comfortable eyepiece of his periscope sight directly in front of him. All the while the laser rangefinder, mounted in the periscope

---

[36]William R. Tuck (COL, USA), Ret., "The AH-56A in Support of Tank Operations," Armor, Vol LXXXVII, No. 6 (November-December 1968), 6.

[37]Theriault, p. 3. [38]Cruz, p. 8. [39]Kluever, p. 8.

> sight, measures the range from the Cheyenne to the point and automatically feeds the range to the central computer.[40]

The weapon fire control system requirements identified the necessity for a capability to attack targets in day or night operations. The simplicity of the stated system requirement, however, was not in proportion to the ultimate system design.

> Fire control and Weaponry Stated System Requirement: the non-visual nature of the night mission requires fire control accuracy as good as the daytime flux sight.[41]

## ARMAMENT

> Cheyenne packs a real punch. It was conceived and designed exclusively as a weapons ship-virtually a flying arsenal. It is capable of carrying wire-guided anti-tank missiles, rockets, a grenade launcher, and a belly machine gun with a complete circle field of fire.[42]

The previous quotation summarizes the AH-56A armament generally. More specifically, AH-56A armament capabilities are divided into "nose and belly-mounted flexible weapon turrets, and wing-mounted 2.75" rockets and TOW missiles."[43] "The wing-mounted external munitions mount on six wing pylons each with a capacity of 2000 pounds for a total of 12,000 pounds."[44]

---

[40] Tuck, p. 4.

[41] Robert J. Walker, Helicopter Fire Control System Project Engineer, Emerson Electric, "Night Observation and Weapon Fire Control System," 26th Annual National Forum, American Helicopter Society, Washington, D.C., June 1970, p. 1.

[42] Kluever, p. 8. [43] Klivaus and Baskind, p. 5.

[44] Tuck, p. 6.

AH-56A CHEYENNE - PHOTOGRAPHED DURING
FLIGHT TESTING. PHOTOGRAPH RELEASED
24 JUNE 1968.

The following is a more detailed summary of armament capabilities.[45]

Internal:

XH-52, 30mm gun - housed in belly turret. 2010 rounds, 400 shots per minute, range 3000 meters, 360 degree traverse, elevation 27 degrees, depression 60 degrees.

XH-51, 40mm grenade launcher-housed in nose turret. 780 rounds, 350 shots per minute, range 1500 meters, 200 degree traverse, elevation 18 degrees, depression 70 degrees.

XH-53, 7.62mm minigun-housed in nose turret. 11,570 rounds, shots per minute selectable at 750, 1500, 3000, 6000, range 1,100 meters. Same elevation and depression as XH-51.

External: (six wing pylons)

Six TOW missiles, 3 each on two inboard wing pylons. (plus)

2.75 inch FFAR, 114 each (or)

2.75 inch FFAR, 152 each on all six wing pylons.

Note: The pylon stations can also mount external fuel tanks for extended range missions.[46]

## NAVIGATION AND COMMUNICATION

The AH-56A is the first Army manned aircraft developed with a fully integrated avionics system. The avionics system characteristics chosen for the AH-56A weapons system are designed to provide the compound vehicle with capability to: navigate from point of departure to destination in all weather, terrain-following automatically with multiple aircraft.[47]

---

[45] Tuck, pgs. 3-10.

[46] Theriault, p. 3.

[47] Cruz, pgs. 9-11. (Author's Note: A highly detailed yet readable explanation of navigation and communication system components, functions and capabilities is contained within the Hogelin and Hancock document previously referenced.)

## DEMISE OF THE AAFSS

Lockheed produced the first Ground Test Vehicle on 3 May 1967.[48] The first flight of the Cheyenne occurred on 21 September 1967 as evidenced in the accompanying photograph. On 12 March 1969 a serious accident occurred "involving the 'half-p-hop' phenomenon - a vertical bounce of the helicopter every two revolutions of the rotor."[49] The reaction was varied as indicated by the following.

> As could be expected in an advanced program of this type, some difficulties were encountered early in the flight test phase. Solutions to the problems, however, have been determined and it is expected that the Cheyenne will again be brought to production status. The Army's Advanced Aerial Fire Support System (AAFSS) rolls back the frontier of technology in many areas. The basic aircraft concept, a compound helicopter, bridges the gap - in flight efficiency--between the helicopter rotor and the airplane wing. Flight tests to date confirm that the fully integrated weapons system is living up to the Army's expectations.[50]

> This history of cost growth has been accompanied by a history of technical difficulties. Over 2 years ago - on January 8, 1968 - the Army exercised its production option under the original Lockheed contract for 375 Cheyenne. Subsequently, the aircraft did not meet its specs in weight, drag, and performance... ...with its cost growth and its recurrent technical difficulties, the Cheyenne program has had a history similar to - indeed worse than - that of the C-5A transport.[51]

---

[48] Cruz, p. 6.

[49] Congressional Record, 91st Congress, 2d Session, 6 August 1970, Senator McIntyre, p. 512913.

[50] AH-56A CHEYENNE, Army Aviation, Vol 18, No. 8 (August 1969), 83.

[51] Senator McIntyre, p. 512913, as previously referenced.

Lockheed engineers identified and corrected two problems with the AH-56A rotor system. The first involved a rotor flapping tendency "potentially troublesome" on the ground at approximately 80 percent rpm. The second involved dynamic instability at high speed, referred to as "half-p-hop".[52] In the Johnston and Cook explanation of the instability and associated AH-56A difficulties the following thought provoking statement was included.

> The development of a new aerial vehicle inevitably brings with it a considerable increase in knowledge. This knowledge should be shared so that there can result the maximum improvement in state of the art. In the case of the Army-Lockheed AH-56A compound rigid-rotor helicopter, advances were made in a number of areas, some particularly applicable to the gyro-controlled rigid-rotor concept of the AH-56A, and some generally applicable to all helicopters.[53]

By August 1970 sufficient attention had been focused on the AH-56A by congressional leaders and by the reported losses of two Cheyenne vehicles to prompt a critical review of the U.S. Army's AAFSS. Summarized, the following observations were made concerning AAFSS.

Against

- Lockheed, the manufacturer, is in a precarious financial position.
- The Cheyenne has had developmental problems; production was cancelled in May 1969 because of these problems and to the present... the system is not operationally ready.
- The USAF has long had the responsibility for close air support and is now seeking to meet that responsibility by developing a system such as the A-X which is forecast to be less expensive, more reliable, with greater lethality and greater survivability, and with a lesser need for change in the existing force structure.

---

[52]Johnston and Cook, pgs. 1-3. (Author's Note: Readers interested in a detailed description of problems associated with rotor instability and handling difficulties encountered with the AH-56A are encouraged to employ this reference.)

[53]Johnston and Cook, p. 1.

• The Army has an excellent gunship in operation now: The AH-1G Cobra which has demonstrated improvement capabilities and which can accept much of Cheyenne's weaponry.

Neutral

• Over $168 million have been invested in the Cheyenne and much of this will be lost if the system is not put into production.

Good

• The Cheyenne can takeoff vertically and operate where the troops do.
• It can operate in bad weather - weather which would ground the A-X.
• It has great single-shot accuracy of firing.
• It can be made available 2-3 years earlier than the A-X.[54]

As the controversy surrounding the AAFSS continued to develop another factor was injected, namely the unveiling of two additional advanced attack helicopters both developed and financed by industry.

On 22 September 1970 Sikorsky introduced the Sikorsky S-67 Blackhawk.[55] On 28 September 1971, Bell Helicopter unveiled the KINGCOBRA.[56]

The concern of the U.S. Army for the viability of the AAFSS is capsulated in the following.

---

[54]M. G. Rawlings, "Must Another Indian Bite The Dust?" Army Aviation, Vol 19, No. 11 (November 1970), 8. (Author's Note: In addition to problems identified in the reference, interested readers should consult the following which specifically addresses the potential problem of lack of adequately trained maintenance personnel: Eugene S. Emmer (MAJ, USA), "Could We Field The Cheyenne?" Army Aviation, Vol 19, No. 1 (January 1970), 15-20.)

[55]"Sikorsky Unveils New Gunship," Army Aviation, Vol 19, No. 10 (October 1970), 38.

[56]"New Silhouette on the Horizon: The Bell KINGCOBRA," Army Aviation, Vol 20, No. 11 (November 1971), 11-12.

> The most important issue in the Army Aviation business in Washington this spring, is the progress of Cheyenne through the Congressional Budget process. For the first time since the original production contract was terminated in 1969 the Army is requesting procurement funds.[57]

The year 1972 was a milestone for the AAFSS development and procurement program.[58] Due to uncertainties with the Lockheed AH-56A Cheyenne and introduction of two company-funded attack helicopters, the U.S. Army decided to conduct an "effectiveness study which examines the Cheyenne and other candidate helicopters."[59] The following information provided by BG Maddox in his role as Director, Army Aviation, reveals the status of the program to date.

> To insure that the best information is available, actual hardware evaluation will be made (on the Cheyenne and) on the candidate systems.
> ...The object of the evaluation is to validate the requirements for an advanced attack helicopter based on cost effectiveness considerations for the various characteristics.
> ...While the Army could have disregarded the company-funded candidates on the basis that it was sold on the Cheyenne, it felt that its selection would be most objective if measurements were made on the other candidates. This decision in no way detracts from the Cheyenne program.[60]

Subsequent discussion by the then spokesman of Army Aviation, BG Maddox, revealed that the Army planned to conduct competitive

---

[57] William J. Maddox, Jr. (BG, USA), Director of Army Aviation, DA, "Progress Report on Cheyenne Procurement," Army Aviation, Vol 20, No. 6 (June 1971), 4.

[58] William J. Maddox, Jr. (BG, USA), Director of Army Aviation, DCSFOR, DA, "We're Reviewing All Proficiency Flying," Army Aviation, Vol 21, No. 1 (January 1972), 9.

[59] Ibid. [60] Maddox, p. 10.

MG WILLIAM J. MADDOX, JR.

U.S. Army Photograph

evaluations of all candidates prior to 1 July 1972 at Hunter Liggett Military Reservation. By this time, it was felt, sufficient data would be available to reinforce the advance attack helicopter cost effectiveness study.[61] From the following statement it is evident that the Army position on the Lockheed Cheyenne had deteriorated perceptibly.

> Obviously, the evaluation must be completely objective. While the Army has confidence in its Cheyenne, it must keep alert to all options which might prove to be more cost effective. The wide disparity in capabilities among the three aircraft provides a number of options which should be evaluated.[62]

Upon completion of the actual flight evaluation, the Army planned a detailed examination of results by employing a special advanced attack helicopter task force set up by LTG John Norton, CG of Combat Developments Command. MG Sidney M. Marks, First Army Chief of Staff would direct the task force.[63]

Describing the Cheyenne in February 1972 BG Maddox said:

> I think the Cheyenne is an excellent, stable, highly capable aircraft. I have flown it. And I would be prepared - if necessary - to take it into combat in a mid-intensity situation such as might develop in Europe, the Middle East or in Southeast Asia.[64]

---

[61] William J. Maddox, Jr. (BG, USA), Director of Army Aviation, OACSFOR, DA, "We Face Mandatory Strength Reductions," Army Aviation, Vol 21, No. 2 (February 1972), 11.

[62] Maddox, p. 12. [63] Ibid.

[64] Lloyd Norman, "Debating The Future of Flying Tanks," Army, Vol 22, No. 2 (February 1972), 20.

MG SIDNEY M. MARKS

U.S. Army Photograph

## SIKORSKY S-67 BLACKHAWK SPECIFICATION SUMMARY[65]

| | |
|---|---|
| Maximum gross weight | 22,000 pounds |
| Range | 250 miles |
| Armament load | 8,000 pounds |

Armament selection: Turret-mounted 7.62mm machine guns; 20-and 30mm cannon; 40mm grenade launcher; wing mounted FFAR and/or TOW missile pods.

| | |
|---|---|
| Primary Mission: | attack |
| Cruise speed | 200+ miles per hour |
| Dive speed | 230 miles per hour |

Powered by two General Electric T-58-5 engines; also capable of accepting GE T-58-16 or Lycoming PLT-27.

| | |
|---|---|
| Wing dimensions | 28 feet (detachable) |

Remarks: Embodied a number of design innovations.

a. An airplane-type vertical fin and a controllable horizontal stabilizer at the end of the fuselage.

b. Set of speed brakes on wings. With the brakes deployed, the time on target is increased by 30 percent, a tighter turning radius is made possible, firing accuracy is improved, and the aircraft can achieve a 38 percent steeper dive.[66]

---

[65]"Sikorsky Unveils New Gunship," Army Aviation, Vol 19, No. 10 (October 1970), 38-39.

[66]"Blackhawk," Bee-Hive, (Fall 1970), 10-13.

SIKORSKY AIRCRAFT'S S-67 BLACKHAWK DEMONSTRATES FIREPOWER BY CARRYING 152 2.75 INCH FFAR. TURRET BENEATH FUSELAGE CAN CARRY EITHER 20MM OR 30MM CANNON. THE BLACKHAWK CAN ALSO BE EQUIPPED WITH OTHER MISSILES AND ROCKETS TO PROVIDE AN ANTITANK CAPABILITY: INCLUDED IN THIS ARMAMENT IS TOW.

Sikorsky Aircraft

SIKORSKY S-67 BLACKHAWK
SPEED/DRAG BRAKES
VISIBLE ON WINGS

Sikorsky Aircraft

BELL KINGCOBRA SPECIFICATION SUMMARY[67]

"Prototype #1 is powered by the UACL Pratt and Whitney T400-CP-400 "Twin Pac," the same as on the Marines' SEACOBRA. (Potential growth 2,400 shp).

Prototype #2, with working systems, will be powered by a Lycoming T55-L-7C engine with 2,850 shaft horsepower, flat rated to 2,000 (shaft horse power)."

| | |
|---|---|
| Slightly elongated fuselage (than AH-1C) | 49 feet |
| Swept tip main rotor diameter | 48 feet |
| Winglength | 13 feet |
| Fuel capacity | 2,300 pounds |

Remarks: "(H)over out of ground effect at 4,000 feet at 95 degrees at a gross weight of 14,000 pounds." The King-Cobra incorporates a multisensor fire-control system for day-night delivery of anti-tank missiles, 20mm shells and rockets (and TOW). Other systems include radar warning, night vision sensors, a self-contained inertial navigator, dual station IIR and improved passive and active defense systems."

---

[67] "Bell Helicopter Company Premieres New KingCobra", Public Relations Bell Helicopter Immediate Press Release (September 1971). (This document also provides the identification of the major subsystem suppliers.)

BELL KINGCOBRA
SIDE VIEW

Bell Helicopter

BELL KINGCOBRA
VIEW FROM SIDE,
BELOW

Bell Helicopter

Army testing of the AH-56A Lockheed Cheyenne and other candidates was a matter of intense Congressional, military and industry interest. As late as 22 May 1972 influential industry spokesman remained favorably disposed to the Cheyenne.[68]

The Lockheed Cheyenne AH-56A program was officially terminated on 9 August 1972 by the Secretary of the Army. The task force headed by MG Marks had submitted its evaluation of the Cheyenne, Blackhawk and KingCobra on 7 August 1972. None of the aircraft had met all of the new requirements of the competitive evaluation to the satisfaction of the task force. The Secretary of the Army in turn announced the termination of the previous AAH program and the initiation of a program to provide the U.S. Army with an AAH "more agile, smaller, and somewhat slower...(with) less sophisticated fire control and navigation equipment that the requirement against which the Cheyenne was developed."[69]

Readers interested in the reasons for rejection of the AAH candidates including handling qualities, technical risk assessment, aircraft vulnerability and vulnerability reduction measures, RDT&E costs, vertical flight performance criteria are encouraged to review

---

[68]Robert R. Ropelewski, "Army Completing AH-56A Tests," Aviation Week & Space Technology, Vol 96, No. 21 (May 1972), 55-59. (Author's Note: This article is a detailed examination of the AH-56A Cheyenne including demonstrated performance data. This constitutes an Aviation Week Pilot Report and should prove highly informative to readers interested in flight and handling characteristics of the aircraft.)

[69]William J. Maddox, Jr. (BG, USA), Director of Army Aviation, OACSFOR, DA, "The Cheyenne Decision," Army Aviation, Vol 21, No. 9 (September 1972), 9.

the following: "Rationale for Army Rejection of AAH Candidates (U)", Chief, Attack Helicopter Review Office, DCSOPS Action Paper (CONFIDENTIAL), 29 January 1973.

After an additional AAH evaluation program of approximately three months the U.S. Army announced official approval and selection of two competitors to provide flying prototypes of the AAH. On 22 June 1973 Secretary of the Army Howard H. Callaway revealed that Bell Helicopter and Hughes Helicopters & Hughes Aircraft were the winners of a competitive evaluation designed to provide the U.S. Army with the AAH early in 1980.[70]

Significant milestones of the revised AAH program follow.[71]

- Contract award - June 1973.
- Mock-up review and critical design reviews were completed during 3d and 4th quarter FY 74.
- Contractor ground test vehicle operation - June 1975.
- First aircraft flight - September 1975.
- Initiation of government competitive tests - June 1976.
- Source Selection Evaluation Board convenes - August 1976.
- Completion of government competitive tests - September 1976.
- DSARC II - November 1976.
- Phase II contract award - November 1976.
- Completion of Phase II development contract - September 1978.
- DSARC III - August 1979.
- First production aircraft delivery - August 1981.

On 31 January 1975, BG Samuel Cockerham, AAH Project Manager, presided at the roll-out presentation of the Bell YAH-63 ground test vehicle.[72]

---

[70]William J. Maddox, Jr. (BG, USA), Director of Army Aviation, OACSFOR, DA, "Reaching Translational Life," Army Aviation (July 1973), 1.

[71]Letter to author from Headquarters, U.S. Army Materiel Command, 28 February 1975.

[72]"The YAH-63/GTV", Army Aviation, Vol 24, No. 2 (February 1975), 3.

BELL YAH-63 ADVANCED ATTACK HELICOPTER (MOCKUP). DESIGNED AS A TWIN-ENGINE, TWO PLACE TANDEM CONFIGURATION, THE HELICOPTER HAS A TURRET MOUNTED 40MM AUTOMATIC CANNON AND WING STATIONS FOR TOW ANTITANK MISSILES AND AERIAL ROCKETS.

Army News Photo Features

BELL YAH-63 ADVANCED ATTACK HELICOPTER
(MOCKUP) FRONT VIEW.

Army News Photo Features

This feat is notable since it occurred prior to the June 1975 deadline; however, in perspective, it took place more than one year after reported deployment of an AAH-type helicopter by the Soviets.

Although detailed characteristics of the proposed U.S. Army AAH are not readily available in unclassified sources the following summarizes basic attributes.

(T)he AAH will have a cruise speed of 150 knots with a payload of eight TOW...missiles; 8,000 rounds of 30mm ammunition; 38 rounds of 2.75 inch rockets and fuel to fly 1.9 hours.[73]

---

[73]"Deployment Trends-1975," United States Army Aviation Digest, Vol 21, No. 4 (April 1975), 16.

BG SAMUEL G. COCKERHAM
PROJECT MANAGER
ADVANCED ATTACK HELICOPTER PROGRAM

U.S. Army Photograph

## SOVIET MI-24 HIND SPECIFICATION SUMMARY[74]

Engines: Two Tsotov TV2-117A turboshaft engines developing 1,500 shp. each on takeoff and 1,000 shp. in cruise at 1,500 ft. altitude.

Specifications: 65.5 ft. in length, wing space is approximately 23.25 ft, overall length is slightly more than 83.6 ft, (from the forward edge of the rotor disk to the rear edge of the tail rotor). Rotor diameter is 70.25 ft, tail rotor diameter is approximately 12.5 ft. Height to the top of the tail rotor disk is approximately 20.5 ft.

Performance: Maximum speed is estimated to be about 140 kt. at maximum gross weight, and cruise speed at about 122 kt. Normal operating range is estimated at about 260 naut. mi.

Remarks: Automatic weapon, believed to be a 23mm, mounted in chin turret. Outboard stations carry two Sagger wire-guided anti-armor missiles each and may have the capability of carrying swatter missile also. Two inboard pylons carry rocket pods. Retractable landing gear.

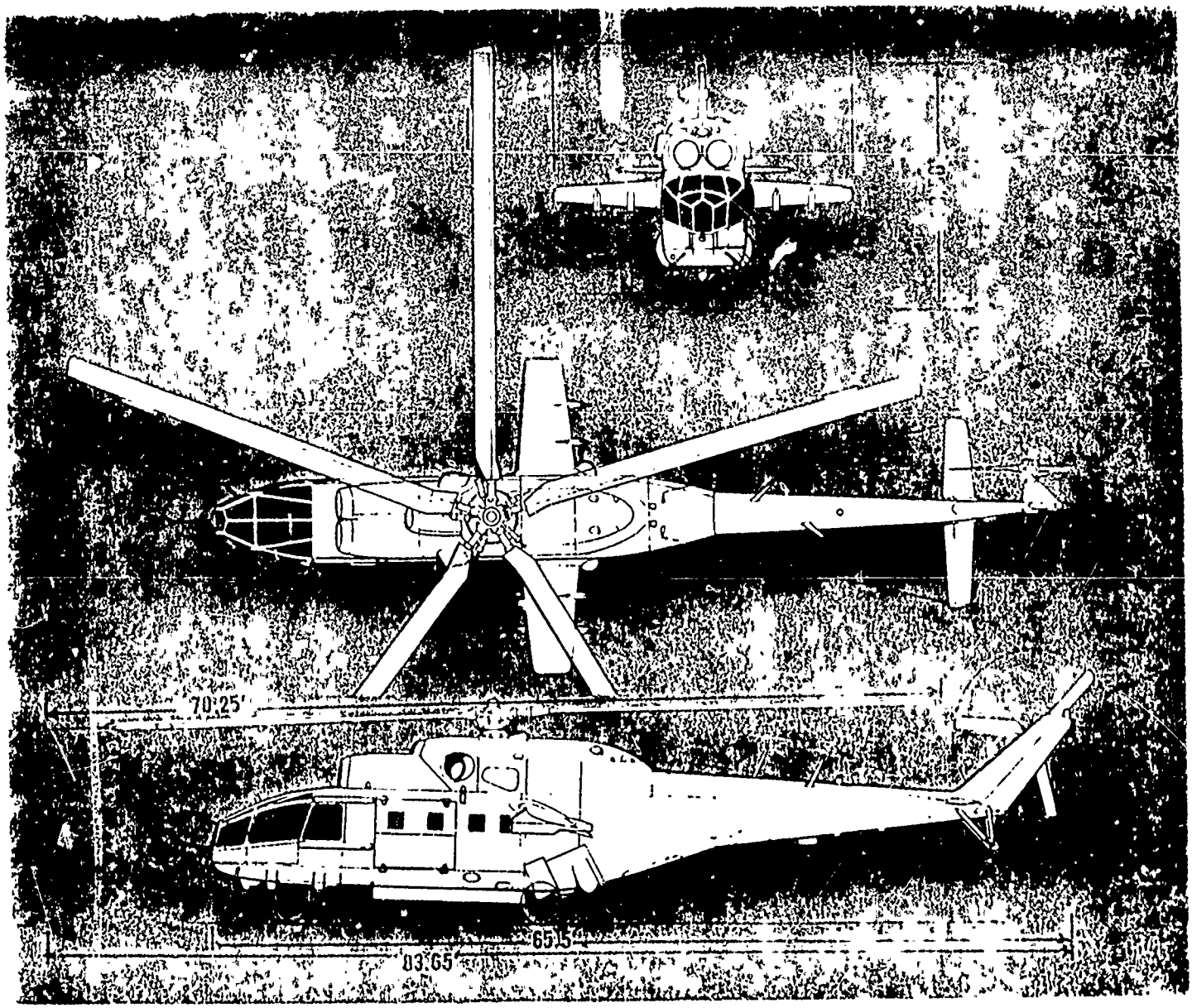
---

[74]"Soviets Deploy Mil MI-24 Hind Gunship," Aviation Week & Space Technology, Vol 100, No. 9 (March 1974), 14-16.

SOVIET MI-24 HIND
ARMED HELICOPTER

Aerial Systems Branch
CACDA

GENERAL ARRANGEMENT DRAWING
SOVIET MI-24 ARMED HELICOPTER




Aviation Week & Space Technology

# CHAPTER V

## SUMMARY

This study has dealt with documenting the historical process of introduction, evolution and development of the advanced attack helicopter within the U.S. Army. In accomplishing this the author identified and confronted two distinct challenges. First, to establish the specific framework within which military aviation itself developed. This framework assumed the following subdivisions which culminated in aviation elements organic to the United States Army as currently known. The study determined that these included:

1861 - Balloon Corps, Army of the Potomac
1862 - Balloon Corps of the Signal Corps
1907 - Aeronautical Division of the Signal Corps
1914 - Aviation Section of the Signal Corps
1918 - Air Service
1941 - Army Air Forces
1947 - United States Army

With the military frameowrk, i.e., the organization into which the AAH would ultimately be introduced, established, the second challenge was to trace the following:

First: The introduction of the helicopter itself into the U.S. Army;

Second: The maturation of the helicopter initially as a new mode of battlefield transportation and later as a mobile weapons platform;

Third: The evolution of the first, crude armed helicopters into sophisticated advanced attack helicopters.

The study traced the military interest in helicopters through five decades to an evaluation of the Peter Cooper Hewitt design in 1918. The first helicopter contracted for by the military was the

de Bothezat machine, the first flight of which occurred on 18 December 1922. The helicopter was found unsuitable. There followed almost twenty years of continued interest and flirtation with the autogiro which attempted to combine proven fixed wing aircraft components with a desire for the potential VTOL characteristics of the helicopter. The second contracted helicopter, the Platt-Le Page XR-1, while retaining wing-like pylons and thereby resembling the fixed wing aircraft, provided impetus to further helicopter development by its successful helicopter mechanical features.

More than thirty years after the initial evaluation and military interest in helicopters, Igor I. Sikorsky delivered the first U.S. military helicopter to the Army Air Forces on 6 May 1942. It became the first helicopter to be used by armed forces in various theaters of war. The age of the helicopter had arrived.

There followed another thirty years of evolution of the helicopter as a flying machine and as a mobile weapons platform. During these thirty years three distinct phases in the process of developing armed helicopters became evident. The first phase, 1942-1955, consisted of occasional interest in and relatively unsophisticated lash-ups of a weapon to a helicopter. This phase was characterized by substantial improvement in helicopters as a means of reliable air transportation, yet unspectacular armament development and helicopter application.

Phase two, 1956-1965, was characterized by significant progress in developing armed helicopters. Initially it was marked by the experiments of enthusiasts such as COL Jay D. Vanderpool who proved by practical demonstration the viability of the helicopter as an aerial

weapons platform. Relative sophistication, however, of helicopter armament subsystems initially remained low since weapons were basically inexpertly fabricated from discarded materials. In the latter stage of this phase, a marked improvement occurred, namely, the development of the first armed helicopter, the Cobra, designed specifically to shoot.

Phase three, 1965 to present, began with the award to Lockheed-California on 3 November 1965 of the Advanced Aerial Fire Support System (AAFSS) contract. The initial stage was characterized by industry and military efforts to provide the U.S. Army with a totally integrated advanced aerial fire support system. This integrated system included the aerial vehicle, fire control, armament, navigation and communication and ground support equipment. It was to have been a significant qualitative improvement in AAFSS technology. For a variety of reasons, as detailed in the study, the AAFSS was cancelled on 9 August 1972 by the Secretary of the Army and a new direction in the program to provide the U.S. Army with an AAH delineated. Since that date a revised RDT&E program, much of it based upon technology generated by the AAFSS program, has been underway. The goal of the revised approach is to provide the AAH by the early 1980's to the military.

In detailing and documenting the process of the introduction, evolution and development of the AAH, the author collected, catalogued and included one hundred and three photographs. Included are seventeen photographs of individuals and groups who were principal agents in the historical process. The remainder of the photographs detail three elements, first, the developing helicopter, second, the developing

helicopter armament systems, and third, the integration and exploitation of the previous technology into the AAH.

The study has resulted in the assembly of extensive information other than that which is included in the review of literature. This information is contained in the Appendixes and Bibliography which in themselves will provide extensive information to interested readers on various aspects of the AAH. Of particular note is the extensive chronology.

## CONCLUSIONS

1. Aviation as an adjunct of the United States military establishment can be traced to the Balloon Corps of the Army of the Potomac, 1861. Thereafter, six distinct reorganizations and redesignations have occurred culminating in the United States Army and its organic aviation elements.

2. The historical process of introduction, evolution and development of the AAH occurred in three separate, identifiable phases. The latter phase is incomplete in that the end product, the AAH, has not yet been produced.

3. At least twice, in two distinct phases of historical evolution, the United States Army or military equivalent of the time, rejected either helicopters or the integrated Advanced Aerial Fire Support System (AAFSS) because of sophistication.

4. The result in both cases has been a quantifiable delay in the process of achieving the AAH as an end product. In the first instance, the cancellation of the de Bothezat contract, a delay of twenty years resulted, 1922-1942. In the second instance, the cancellation of the AAFSS, a delay of approximately ten years resulted.

5. The RDT&E process contains a degree of technical risk which has been proven to be a significant factor in the helicopter weapon system development process. The technical risk associated with development of military hardware is directly related to the degree which the RDT&E process strains the current state of the art.

6. The United States Army or its military equivalent of the time has been associated with the integration of helicopters and their application in military roles for fifty-seven years. Thirty-three years have elapsed since helicopter armament experiments commenced.

7. The U.S. Army has made significant progress in helicopter armament subsystems during the last twenty years. During this period one helicopter designed specifically as an aerial weapons platform, i.e., to shoot, has been introduced in the U.S. Army. This occurred during the last half of this twenty year period. To date a totally integrated aerial fire support system employing a helicopter has not been developed.

8. With the introduction of the AAH in the early 1980's the process of evolution of a helicopter aerial weapons system will mark four decades of gradual refinement. It will follow by approximately six years a Soviet introduction of a comparable advanced attack helicopter.

# APPENDIXES

## APPENDIX A

## INFORMATION SOURCES

BG Samuel G. Cockerham
Project Manager
Advanced Attack Helicopter System
Post Office Box 209
St. Louis, Missouri 63166

GEN Hamilton H. Howze, USA (Ret.)
Bell Helicopter Company
Post Office Box 482
Fort Worth, Texas 76101

LTG Harry W. O. Kinnard, USA (Ret.)
181 Clyde Road
Athens, Georgia 30601

COL Jay D. Vanderpool, USA (Ret.)
1650 Chaplene Lane
Sarasota, Florida 33587

American Helicopter Society
30 East 42d Street
New York, New York 10017

Army Aviation Association of America
1 Crestwood Road
Westport, Connecticut 06880

Army Times Publishing Company
475 School Street, SW
Washington, D. C.

Association of the United States Army
1529 18th Street, NW
Washington, D. C. 20036

Aviation Systems Division
Weapons Systems Directorate
Office, Chief of Research, Development & Acquisition
Department of the Army
Washington, D. C.

Battelle Memorial Institute
505 King Avenue
Columbus, Ohio 43201

Bell Helicopter Company
Post Office Box 482
Fort Worth, Texas 76101

Curator
U.S. Army Aviation Museum
Fort Rucker, Alabama 36360

Curator
U.S. Army Communications Electronics Museum
Myer Hall, Building 1207
Fort Monmouth, New Jersey 07703

Editor
American Enterprise Institute for Public Policy Research
1150 Seventeenth Street, NW
Washington, D. C. 20036

Editor
Journal of the American Aviation Historical Society
Post Office Box 99
Garden Grove, California 92642

Editor, Armor
Post Office Box 0
Fort Knox, Kentucky 40121

Editor, Aviation Digest
Post Office Drawer
Fort Rucker, Alabama 36360

Editor
U.S. Naval Institute Proceedings
225 Park Avenue
New York, New York 10017

Hughes Aircraft Company
Aerospace Group
Centinella and Teace Streets
Culver City, California 90230

Information Officer
First Cavalry Division
Fort Hood, Texas 76544

Information Officer
Project MASSTER
HQ, III Corps and Fort Hood
Fort Hood, Texas 76544

Information Officer
U.S. Army Aviation School
Fort Rucker, Alabama 36360

Information Officer
U.S. Army Materiel Command
AMC Building
5001 Eisenhower Avenue
Alexandria, Virginia 22304

National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151

Sikorsky Aircraft Division
United Aircraft Corporation
North Main
Stratford, Connecticut 06602

Editor, Infantry
Post Office Box 2005
Fort Benning, Georgia 31905

Helicopter Association of America
1156 15th Street, NW
Washington, D. C. 20005

IOIU
Department of the Army
Building 160/2, WNYA
2d and M Streets, SE
Washington, D. C. 20315

Information Officer
HQ, III Corps and Fort Hood
Fort Hood, Texas 76544

Information Officer
U.S. Army Armor School
Fort Knox, Kentucky 40121

Information Officer
U.S. Army Aviation Systems Command
Post Office Box 209
St. Louis, Missouri 63166

Lockheed Aircraft Corporation
2555 North Hollywood Way
Burbank, California 91503

Scientific Information Exchange
209 Madison National Bank Building
1730 W Street, NW
Washington, D. C. 20036

Technical Information Service
American Institute of Aeronautics and Astronautics
750 Third Avenue
New York, New York 10017

U.S. Army Armor School
Command and Staff Department
Air Cavalry and Attack Helicopter Branch
Fort Knox, Kentucky 40121

U.S. Army Combat Development Activity
Directorate of Combat and Combat Support Systems
Aerial Systems Branch
Fort Leavenworth, Kansas 66027

U.S. Army Combat Development Activity
Special Readiness Study Group
Fort Leavenworth, Kansas 66027

U.S. Army Aviation Center and Fort Rucker
Deputy for Developments
Fort Rucker, Alabama 36360

U.S. Army Combat Development Activity
Directorate of Combat and Combat Support Systems
Armor Systems Branch
Fort Leavenworth, Kansas 66027

# APPENDIX B

CONTENTS

ACQUISITION COSTS OF MAJOR LAND FORCES MODERNIZATION AND IMPROVEMENT PROGRAM[1]*

ATTACK HELICOPTERS

(DOLLARS IN MILLIONS)

| | FY 1973 ACTUAL FUNDING | FY 1974 PLANNED FUNDING | FY 1975 PROPOSED FUNDING |
|---|---|---|---|
| Procurement of TOW Modification for COBRA Attack Helicopter (AH-1) | - | 73 | 87 |
| Procurement of COBRA-TOW Attack Helicopter (AH-1Q) | - | - | 28 |
| Procurement of SEA COBRA Attack Helicopter | 34 | 26 | 31 |
| Development of Advanced Attack Helicopter | 20 | 49 | 61 |

[1]Includes costs of RDT&E, procurement of the system and initial spaces, and directly related military construction.

*James R. Schlesinger, Report of the Secretary of Defense to the Congress on the FY 1975 Defense Budget and FY 1975-1979 Defense Program, (Washington: Government Printing Office, 1974), p. 102.

EXTRACT: NARRATIVE OF SECRETARY OF DEFENSE JAMES R. SCHLESINGER CONCERNING THE ATTACK HELICOPTER PROGRAM[1]

Cobra-TOW Modification

Last year $73 million was provided to modify the first 101 AH-1G Cobra helicopters (out of a prospective total of 298) to carry the TOW missile. Eight R&D prototype Cobra-TOW helicopters (designated the AH-1Q) had been previously funded.

We still plan to complete the modification of the remaining 189 AH-1Gs to the Cobra-TOW configuration in FY 1975. Evaluation of the performance of the prototype vehicles, however, indicates that engine upgrading and a change in the transmission will be needed if the AH-1Q is to carry a full load of eight TOW missiles in addition to the normal armament and fuel load of the AH-1G. The AH-1Q as presently configured can carry 2 to 6 TOWs (depending on the weather and altitude) in addition to its other armament and fuel load.

Accordingly, we now propose to increase the power of the current AH-1 engine and substitute the gear boxes and transmission used in the Marine Corps AH-1J for those now used in the AH-1G. We are requesting a total of $87 million in the FY 1975 Budget for the modification of the 189 AH-1Gs to this upgraded configuration. A final decision on the procurement of these modifications, however, will not be made until the test and evaluation of the improved AH-1Q has been satisfactorily completed.

Cobra-TOW Procurement

In addition to modifying a total of 298 AH-1Gs to the upgraded configurations, we also propose to buy about 300 new improved configuration AH-1s during the FY 1975-79 period. The Army needs a total of about 1335 attack helicopters to equip the current force structure (active and reserve). The current inventory is now about 760 below that figure, and the shortfall is expected to increase even further due to peacetime attrition and the phasing out of approximately 300 UH-1M utility helicopters now used as substitute attack helicopters.

[1] James R. Schlesinger, Report of the Secretary of Defense to the Congress on the FY 1975 Defense Budget and FY 1975-1979 Defense Program, (Washington: Government Printing Office, 1974), p. 108-110. (Author's Note: The information contained in this Appendix establishes the status of the attack helicopter program as of 4 March 1974, the date of Secretary Schlesinger's address.)

The only new attack helicopter in development, the AAH, is expected to cost more than twice as much as the upgraded AH-1Q. Consequently, we would buy only enough AAHs to meet the most demanding requirement. The procurement of some 300 upgraded AH-1s in the FY 1975-79 period would not only avoid the potential shortage but also maintain a "warm" production base. A total of $28 million is included in the FY 1975 Budget for the procurement of the initial increment of 21 upgraded AH-1Qs.

Sea Cobra Attack Helicopter

The Marine Corps in recent years has been buying a twin engine version of the AH-1 for over-water operations. Forty-nine of these AH-1Js were procured in FY 1969 and prior years, 20 in FY 1973, and 20 more were funded in FY 1974. Another 35 are needed to complete the equipping of three active squadrons and two training elements (a total of 84 UE aircraft).

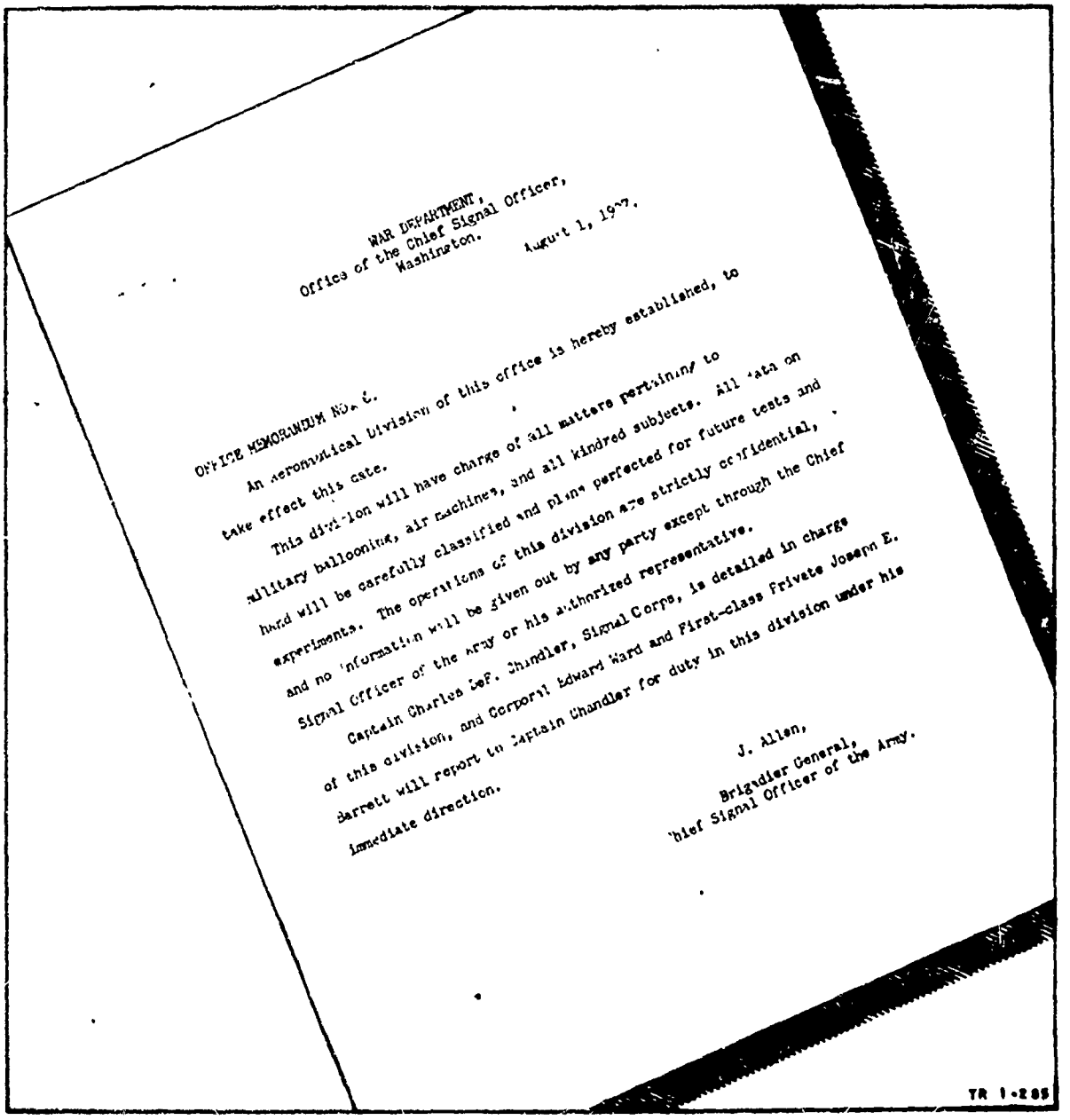
We believe that some of the AH-1Js should be configured to carry TOW, and all should be configured to carry the newly developed protective devices (e.g., infrared suppressors, detectors, jammers, and decoys), in addition to their current payload. In order to do so, however, the payload capability of the aircraft clearly needs to be improved substantially. The AH-1J (Improved) will cost about a half a million dollars more per aircraft than the current AH-1J ($1.5 million vs. $1.0 million). But we believe that the enhanced capabilities of the AH-1J (Improved) will fully justify the additional cost.

Accordingly, we now propose to buy 15 of the improved AH-1Js in FY 1974, instead of the 20 current model AH-1Js previously planned. The $31 million included in the FY 1975 Budget for this program would provide $27 million for another 20 AH-1J (Improved) Attack Helicopters, plus about $4 million for advanced procurement for the final 20 to be procured in FY 1976.

Advanced Attack Helicopter (AAH)

The FY 1975 Budget also includes $61 million to continue development of the AAH for the longer term modernization of our attack helicopter force. As you know, the AAH is the successor to the Cheyenne attack helicopter program that was terminated by the Army in August 1972. The Army, OSD, and the Special Subcommittee on Close Air Support of the Senate Armed Services Committee (in its Report issued in June 1972) have all concluded that there is a need for both fixed wing and attack helicopter close air support on the modern battlefield. The AAH would help to fulfill the attack helicopter portion of this mission in the 1980s and beyond.

The AAH program is being pursued on a design-to-cost basis in the hope that we can develop a suitable attack helicopter that is less costly and less complex than the Cheyenne. Development contracts have been awarded to two contractors. Each will fabricate two flying prototypes to be evaluated in a competitive fly-off in March 1976. If all goes well, the first production AAHs, for test and then inventory, would be procured in FY 1978-79.



WAR DEPARTMENT,
Office of the Chief Signal Officer,
Washington. August 1, 1907.

OFFICE MEMORANDUM No. 1.

An Aeronautical Division of this office is hereby established, to take effect this date.

This division will have charge of all matters pertaining to military balloons, air machines, and all kindred subjects. All data on hand will be carefully classified and plans perfected for future tests and experiments. The operations of this division are strictly confidential, and no information will be given out by any party except through the Chief Signal Officer of the Army or his authorized representative.

Captain Charles DeF. Chandler, Signal Corps, is detailed in charge of this division, and Corporal Edward Ward and First-class Private Joseph E. Barrett will report to Captain Chandler for duty in this division under his immediate direction.

J. Allen,
Brigadier General,
Chief Signal Officer of the Army.

TR 1-285

APPENDIX
U.S. CONGRESS

EXTRACT: PUBLIC LAW 253-80th CONGRESS
CHAPTER 343-1st SESSION
S. 758
AN ACT

To promote the national security by providing for a Secretary of Defense; for a National Military Establishment; for a Department of the Army, a Department of the Navy, and a Department of the Air Force; and for the coordination of the activities of the National Military Establishment with other departments and agencies of the Government concerned with the national security.

That this Act may be cited as the "National Security Act of 1947".

DEPARTMENT OF THE ARMY

Sec. 205. (a) The Department of War shall hereafter be designated the Department of the Army, and the title of the Secretary of War shall be changed to Secretary of the Army. Changes shall be made in the titles of other officers and activities of the Department of the Army as the Secretary of the Army may determine.

(b) All laws, orders, regulations, and other actions relating to the Department of War or to any officer or activity whose title is changed under this section shall, insofar as they are not inconsistent with the provisions of this Act, be deemed to relate to the Department of the Army within the National Military Establishment or to such officer or activity designated by his or its new title.

(c) The term "Department of the Army" as used in this Act shall be construed to mean the Department of the Army at the seat of government and all field headquarters, forces, reserve components, installations, activities, and functions under the control or supervision of the Department of the Army.

(d) The Secretary of the Army shall cause a seal of office to be made for the Department of the Army, of such design as the President may approve, and judicial notice shall be taken thereof.

(e) In general the United States Army, within the Department of the Army, shall include land combat and service forces and such aviation and water transport as may be organic therein. It shall be organized, trained, and equipped primarily for prompt and sustained combat incident to operations on land. It shall be responsible for the preparation of land forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with integrated joint mobilization plans, for the expansion of peacetime components of the Army to meet the needs of war.

# H-25

Eight-place utility helicopter. Piasecki Aircraft Corp., Philadelphia, Pa.

## ENGINES

One Continental R-975-42 engine of 475 hp.

## ROTOR SYSTEM

Tandem three-bladed rotor system.

## SPECIFICATIONS

Rotor diameter: 35 ft. Gross weight: 5,500 lb.

## PERFORMANCE

Cruise speed (SL): 92 mph. Service ceiling: 12,700 ft. Max. range: 357 st. mi.

## REMARKS

The H-25 was developed for the Navy for rescue operations. With minor modifications, it met Army operational needs in cargo and utility missions. Fifty H-25s were procured by the Army, but were later turned over to the Navy for use.

---

(Author's Note: U.S. Army Fact Sheet for H-25 unavailable. Source: "H-25," Army Aviation, Vol 17, No. 8 (August 1968), 51.)

# CH-21 SHAWNEE

Cargo helicopter. Boeing Vertol Div., Morton, Pa.

## ENGINES

One Curtiss-Wright R-1820-103 developing 1,425 hp.

## ROTOR SYSTEM

Tandem 3-bladed rotors.

## SPECIFICATIONS

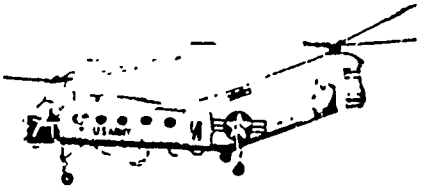
Rotor diameter: 44 ft. Length: 52 ft. 7 in. Height: 15 ft. 9 in. Empty weight: 8,950 lb. Gross weight: 15,200 lb. Places: Crew of three and 20 troops or 12 litters.

## PERFORMANCE

Max. speed (SL): 127 mph. Cruise speed (SL): 98 mph. Service ceiling: 18,600 ft. Max. range: 245 st. mi. Endurance: 2 hrs. 4[illegible] min.

## REMARKS

Since the initial date of procurement in June 1950, the Army purchased 334 CH-21s of all models. The Shawnee was, until late 1963, the workhorse of Vietnam, when it was phased out, being replaced by the ubiquitous Huey.



(Author's Note: U.S. Army Fact Sheet for CH-21 unavailable. Source: "CH-21 Shawnee," Army Aviation, Vol 17, No. 8 (August 1968), 62.)

# U.S. ARMY FACT SHEET


**OCT., 1969**
**AIRCRAFT**
**No. 15**

## OH-13H (SIOUX)

### CHARACTERISTICS

| PHYSICAL | |
|---|---|
| Type | Observation |
| Length | 41.4 feet |
| Rotor diameter | 35.1 feet |
| Height | 9.5 feet |
| Weight | |
| (empty) | 1850 pounds |
| (gross) | 2750 pounds |
| Fuel capacity | 41 gallons |
| Engine | 6-cylinder, 4-cycle, horizontally opposed, gasoline |
| Horsepower | 220 |

| PHYSICAL (Continued) | |
|---|---|
| Armament | Provision for two fixed 7.62mm machineguns (optional) |

| OPERATIONAL | |
|---|---|
| Maximum speed | 91 mph |
| Cruising speed | 86 mph |
| Range | 219 miles |
| Ceiling | 14,000 feet |
| Rate of climb | 1690 feet per minute |
| Payload | 640 pounds |

### EMPLOYMENT

The OH-13H observation helicopter is used for training, observation, reconnaissance, rescue and general utility missions by division, brigade and battalion-size units.

## DEVELOPMENT BACKGROUND

Produced by the Bell Helicopter Company of Fort Worth, Texas, the OH-13H was developed in 1955 as an improvement upon the OH-13G. The last OH-13H to be built rolled off the assembly line in 1959.

## DESCRIPTION

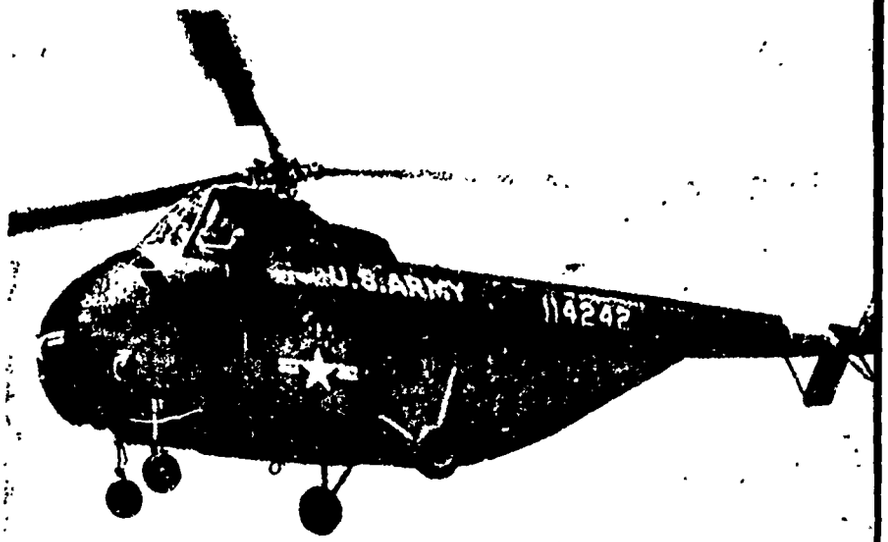
The OH-13H is a three-place, single main rotor and tail rotor helicopter. The crew compartment is covered by a bubble canopy. The aircraft is restricted to non-instrument flight.

# U.S. ARMY FACT SHEET

**NOV., 1969**

# AIRCRAFT

**NO.18**




# UH-19D (CHICKASAW)

## CHARACTERISTICS

### PHYSICAL

| | |
|---|---|
| Type | Utility |
| Length | 62 feet 3 inches |
| Rotor diameter | 53 feet |
| Height | 15 feet 3 inches |
| Weight | |
| (empty) | 5700 pounds |
| (gross) | 7900 pounds |
| Fuel capacity | 175 gallons |
| Engine | 7-cylinder, radial reciprocal |

### PHYSICAL (Continued)

| | |
|---|---|
| Horsepower | 800 |

### OPERATIONAL

| | |
|---|---|
| Maximum speed | 132 mph |
| Cruising speed | 109 mph |
| Range | 336 miles |
| Rate of climb | 100 feet per minute |
| Ceiling | 8200 feet |
| Payload | 680 pounds |

## EMPLOYMENT

The principal missions of the UH-19D are transportation of cargo and troops and observation and rescue missions. The aircraft is also used for medical evacuation.

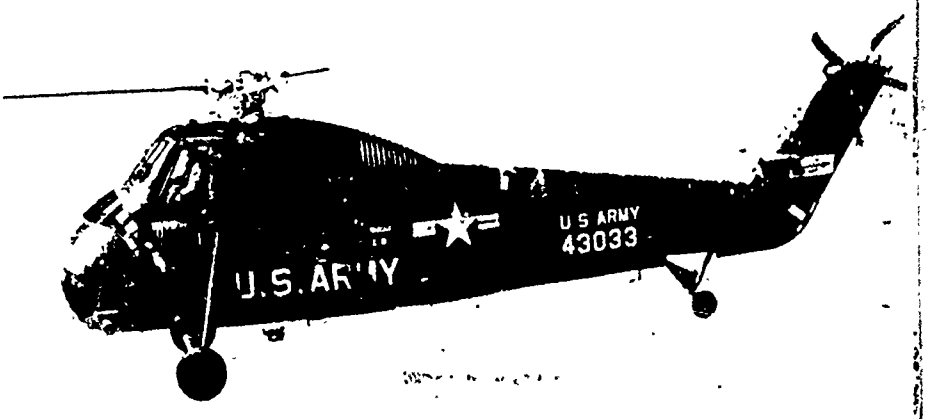
## DEVELOPMENT BACKGROUND

The UH-19D was manufactured by Sikorsky Aircraft Division of United Aircraft Corporation. It was originally developed for the U.S. Air Force as the H-19, for use in rescue operations. The Army tested and evaluated the aircraft in January of 1952, and the first UH-19D was delivered to the Army in July of 1953. The last UH-19D was delivered in March, 1959.

## DESCRIPTION

The UH-19D "Chickasaw" is a single main rotor and tail rotor helicopter capable of carrying 10 passengers (including pilot). The engine is mounted in the nose on a 35-degree incline, driving the main and tail rotors through transmissions and a series of shafts. The helicopter has a four-wheel, fixed landing gear assembly.

# U.S. ARMY FACT SHEET




**OCT., 1969**
**AIRCRAFT**
**No. 17**

# CH-34C (CHOCTAW)

## CHARACTERISTICS

### PHYSICAL

| | |
|---|---|
| Type | Transport |
| Length | 65 feet 10 inches |
| Rotor diameter | 56 feet |
| Height | 15 feet 11 inches |
| Weight | |
| (empty) | 9441 pounds |
| (gross) | 13,600 pounds |
| Fuel capacity | 262 gallons |
| Engine | 9-cylinder, air-cooled, radial reciprocal |

### PHYSICAL (Continued)

| | |
|---|---|
| Horsepower | 1525 |

### OPERATIONAL

| | |
|---|---|
| Maximum speed | 171 mph |
| Cruising speed | 108 mph |
| Range | 274 miles |
| Ceiling | 10,400 feet |
| Rate of climb | 1120 feet per minute |
| Payload | 3759 pounds |

### EMPLOYMENT

The principal mission of the CH-34C helicopter is the transportation of cargo and personnel.

## DEVELOPMENT BACKGROUND

Manufactured by Sikorsky Aircraft Division of United Aircraft Corporation, the CH-34C light transport helicopter is similar to the CH-34A, from which it was developed. The major improvement in the "C" model was the addition of automatic stabilization equipment (ASE). The basic model has also been used by the U.S. Air Force, Navy and Coast Guard. The first H-34A flew in December, 1954. Production of the CH-34C was completed in January, 1959.

## DESCRIPTION

The CH-34C "Choctaw" is a single main rotor and tail rotor helicopter equipped with four-bladed rotors. The engine is located in the nose, pointed up and toward the rear, driving the rotors through transmissions and a series of drive shafts. The main rotor flight controls incorporate independent but parallel hydraulic servo systems. The landing gear is a two main and one tail wheel arrangement.

# U.S. ARMY FACT SHEET

JULY, 1970

# AIRCRAFT NO. 22


# UH-1A (IROQUOIS)

## CHARACTERISTICS

### PHYSICAL

| | |
|---|---|
| Type | Utility |
| Length | 38 feet 5 inches |
| Height | 11 feet 4 inches |
| Main rotor diameter | 44 feet |
| Weight (empty) | 3930 pounds |
| (gross) | 7200 pounds |
| Fuel capacity | 125 gallons |
| Engine | Shaft turbine |
| Horsepower | 860 |
| Armament | None |

### OPERATIONAL

| | |
|---|---|
| Maximum speed | 121 mph (105 kn.) |
| Cruising speed | 78 mph (68 kn.) |
| Range | 84 miles (73 nautical miles) |
| Hover ceiling | 11,500 feet |
| Service ceiling (approx.) | 14,000 feet |
| Payload | 3270 pounds |
| Rate of climb | 2130 feet per minute |
| Internal cargo space | 107 cubic feet |
| Crew | 2 men |
| Passengers | 4 |
| Litter patients | 2 |

## EMPLOYMENT

Originally designed as a medical evacuation helicopter, the UH-1A also served as an armed escort helicopter and is currently primarily utilized as an instrument trainer by the U.S. Army Aviation School.

## DEVELOPMENT BACKGROUND

Development of the UH-1 series of helicopters began in 1954 with a formal design competition initiated by the U.S. Army Medical Corps for a medical evacuation helicopter. Winner of the design competition was the Bell Helicopter Company, of Fort Worth, Texas, with its design for what are now UH-1s. A full-scale mock-up was produced in 1955. After testing and evaluation was completed production of UH-1s began. Between June 1959 and November 1961, 247 UH-1s were delivered to the Army by Bell.

## DESCRIPTION

The UH-1A is a six-place, single main rotor and tail rotor helicopter with an aluminum alloy monocoque fuselage and skid-type landing gear. It is powered by an 860-horsepower shaft turbine engine flat-rated to 770 horsepower. The main rotor is two-bladed and is mounted in a "teetering" assembly. Both the main and tail rotors are of aluminum "honeycomb" construction.

# U.S. ARMY FACT SHEET

JULY, 1970

# AIRCRAFT NO. 23

# UH-1B (IROQUOIS)

## CHARACTERISTICS

### PHYSICAL

| | |
|---|---|
| Type | Utility |
| Length | 38 feet 5 inches |
| Height | 12 feet 8 inches |
| Main rotor diameter | 44 feet |
| Weight (empty) | 4523 pounds |
| (gross) | 8500 pounds |
| Fuel capacity | 165 gallons |
| Engine | Shaft turbine |
| Horsepower | 1100 |
| Armament | 2 door-mounted .50-cal. or 7.62mm machineguns and/or optional armament |

### OPERATIONAL

| | |
|---|---|
| Maximum speed | 109 mph (95 knots) |
| Cruising speed | 86 mph (75 knots) |
| Range | 150 miles (130 nautical miles) |
| Payload | 3977 pounds |
| Hover ceiling | 12,300 feet |
| Service ceiling (approx ) | 14,000 feet |
| Rate of climb | 2400 feet per minute |
| Internal cargo space | 115 cubic feet |
| Crew | 2 men |
| Passengers | 7 |
| Litter patients | 3 |

## EMPLOYMENT

Originally designed for the same basic mission as the UH-1A (medical evacuation), but with increased power and payload, the UH-1B "Iroquois" has been heavily utilized to transport infantry and support elements; as an armed escort for transport helicopters; for command, control and communication; on reconnaissance, security and screening operations; and to provide suppressive fire as an integral part of land force maneuver and fire plans.

## DEVELOPMENT BACKGROUND

The UH-1B evolved from the UH-1A in order to provide increased troop and cargo carrying capability and increased speed and range. The major improvement was use of a more powerful engine. The UH-1A's engine developed 770 horsepower. The UH-1B originally utilized a 960 horsepower engine, and later production models were equipped with an 1100 horsepower version. The Bell Helicopter Company, of Fort Worth, Texas, produced the UH-1B aircraft from March 1961 to November 1965. During that time, 988 UH-1Bs were delivered to the Army.

## DESCRIPTION

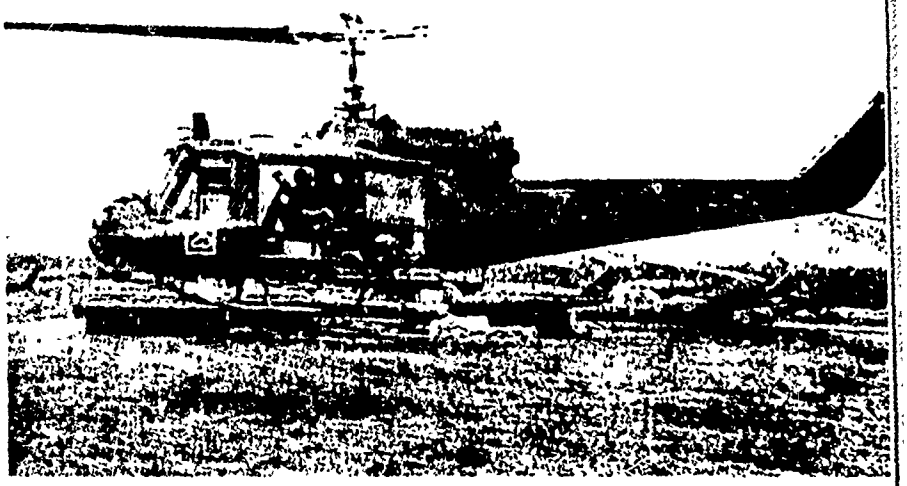
The UH-1B is a nine-place, single main rotor and tail rotor utility helicopter with an aluminum alloy monocoque fuselage and skid-type landing gear. As with the other UH-1 models, the UH-1B has a two-bladed, "teetering" main rotor of aluminum "honeycomb" construction. The airframe is provided with nose and side-of-fuselage hard points capable of accepting a variety of weapons. Among the optional weapons are: a pylon-mounted 2.75-inch folding fin aerial rocket launcher, quad 7.62mm machineguns, a nose-mounted 40mm grenade launcher, or antitank guided missiles.

# U.S. ARMY FACT SHEET

**SEPTEMBER 1970**

# AIRCRAFT

**NO. 24**



# UH-1C ( IROQUOIS )

## CHARACTERISTICS

### PHYSICAL

| | |
|---|---|
| Type | Utility |
| Length | 42 feet 7 inches |
| Height | 12 feet 8 inches |
| Main rotor diameter | 44 feet |
| Weight | |
| (empty) | 4827 pounds |
| (gross) | 9500 pounds |
| Fuel capacity | 242 gallons |
| Engine | Shaft turbine |
| Horsepower | 1100 |
| Armament | Optional |

### OPERATIONAL

| | |
|---|---|
| Maximum speed | 137 mph (119 knots) |
| Cruising speed | 127 mph (110 knots) |
| Range | 299 miles (260 nautical miles) |
| Payload | |
| (normal) | 2685 pounds |
| (useful) | 4673 pounds |
| Hover ceiling | 12,100 feet |
| Service ceiling | 16,000 feet |
| Rate of climb | 1849 feet per minute |
| Internal cargo space | 140 cubic feet |
| Crew | 2 men |
| Passengers | 7 |
| Litter patients | 3 |

## EMPLOYMENT

The UH-1C "Iroquois" is used to perform missions similar to those of the UH-1B: transport of infantry and support troops; armed escort for troop transports; command, control and communication; reconnaissance; and suppressive fire missions in support of land force maneuver and fire plans.

## DEVELOPMENT BACKGROUND

The UH-1C evolved from the UH-1B and is almost identical in appearance to it. The UH-1C embodies an improved rotor system, which provides it with a larger payload capacity than the UH-1B, and a larger fuel capacity, which permits increased operating range. The Bell Helicopter Company, of Fort Worth, Texas, manufactured the UH-1C from June 1965 through 1967, and delivered a total of 752 UH-1Cs for Army use.

## DESCRIPTION

The UH-1C "Iroquois" is a nine-place, single main rotor and tail rotor utility helicopter which is capable of being fitted for a variety of roles. As a troop transport, the UH-1C can carry seven fully equipped combat troops in addition to its pilot and aircraft commander. For medical evacuation missions it can be fitted with three litters. When used as an armed escort, or for suppressive fire missions, the nose and side-of-fuselage hard points may carry a wide range of weapons systems, including pylon-mounted 2.75-inch folding fin aerial rocket launchers, a nose-mounted 40mm grenade launcher, antitank guided missiles, two miniguns, or manually operated 7.62mm or .50-caliber machineguns.

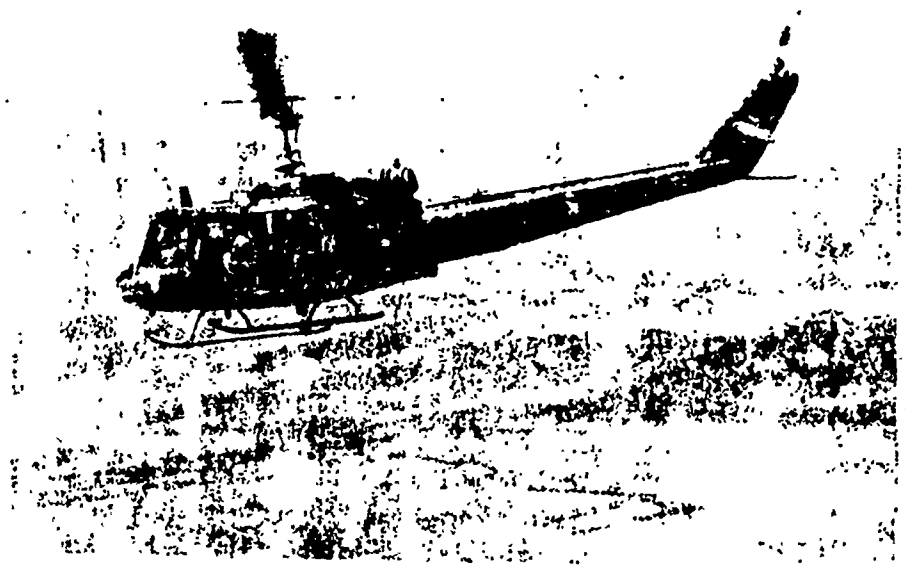
The UH-1C is the third member of the "Huey" family, and, like its predecessors and successors, has a monocoque aluminum alloy fuselage and a two-bladed "teetering" main rotor assembly. Both rotors are constructed of "honeycomb" aluminum.

# U.S. ARMY FACT SHEET

JULY, 1970

# AIRCRAFT

NO. 25*



## UH-1D (IROQUOIS)

### CHARACTERISTICS

#### PHYSICAL

| | |
|---|---|
| Type | Utility |
| Length | 40 feet 8 inches |
| Height | 13 feet |
| Main rotor diameter | 48 feet |
| Weight (empty) | 4800 pounds |
| (gross) | 9500 pounds |
| Fuel capacity | 220 gallons |
| Engine | Shaft turbine |
| Horsepower | 1100 |
| Armament | 2 pintle-mounted machineguns in door (7.62mm or 50-caliber) |

#### OPERATIONAL

| | |
|---|---|
| Maximum speed | 126 mph (110 kn.) |
| Cruising speed | 106 mph (92 kn.) |
| Range | 223 miles (194 nautical miles) |
| Payload | 4700 pounds |
| Hover ceiling | 8700 feet |
| Service ceiling (approx.) | 16,000 feet |
| Rate of climb | 1630 feet per minute |
| Internal cargo space | 220 cubic feet |
| Crew | 2 men |
| Passengers | 11 |
| Litter patients | 6 |

## EMPLOYMENT

The UH-1D serves in a variety of roles. Its main mission is transport of infantry assault and support elements. Other missions performed by the UH-1D include command, control and communication; reconnaissance, security and screening operations; and suppressive fire missions as an integral part of land force deployment operations. The UH-1D is organic to division, brigade, and aviation elements.

## DEVELOPMENT BACKGROUND

The UH-1D is the fourth in the series of UH-1 "Iroquois" helicopters which are better known as "Hueys"--a nickname derived from their original designation, HU-1. The original "Iroquois" was developed as a result of design competition initiated in 1954 by the U.S. Army Medical Corps for a medical evacuation helicopter. The UH-1D is basically a modified UH-1B. The "D" model features a longer fuselage and a main rotor with a 4-foot increase in diameter. These and other modifications provided the increased space and load lifting capacity required to permit deployment of a complete infantry squad in a single aircraft. The UH-1D is manufactured by the Bell Helicopter Company, of Fort Worth, Texas.

## DESCRIPTION

The UH-1D is a single main rotor and tail rotor utility helicopter with a monocoque aluminum alloy fuselage. The main rotor assembly is of the "teetering" variety. Both rotors are of aluminum "honeycomb" construction. The UH-1D is capable of carrying a two-man crew and either 11 passengers or 6 litter patients.

In addition to the two machineguns, the aircraft is equipped with nose and side-of-fuselage hard points capable of accepting a variety of weapons systems.

Like other UH-1 models, the UH-1D is equipped with skid-type landing gear.

*This Fact Sheet supersedes Aircraft Fact Sheet #1, dated July 1966, which is rescinded.



GPO 896-45

# U.S. ARMY FACT SHEET

**JANUARY 1972**

# AIRCRAFT

**NO. 26**

## UH-1H (IROQUOIS)

### CHARACTERISTICS

#### PHYSICAL

| | |
|---|---|
| Type | Utility |
| Length | 40 feet, 8 inches |
| Height | 13 feet, 7 inches |
| Main rotor diameter | 48 feet, 3 inches |
| Tail rotor diameter | 8 feet, 6 inches |
| Weight (empty) | 4,800 pounds |
| (gross) | 9,500 pounds |
| Fuel capacity | 220 gallons |
| Engine | Shaft turbine |
| Horsepower | 1,100 |
| Armament | Optional |

#### OPERATIONAL

| | |
|---|---|
| Maximum speed | 126 mph (110 kn.) |
| Cruising speed | 106 mph (92 kn.) |
| Range | 223 miles (194 nautical miles) |
| Payload | 4,700 pounds |
| Hover ceiling | 8,700 feet (OGE) |
| Service ceiling | 16,000 feet |
| Rate of climb | 1,630 feet per minute |
| Internal cargo space | 220 cubic feet |
| Crew | 2 men |
| Passengers | 11 |
| Litter patients | 6 |

## EMPLOYMENT

The UH-1H is a highly versatile aircraft which serves the Army in a number of roles. Its main mission is transport of infantry assault and support elements. The aircraft is also used in command, control and communication; reconnaissance, security and screening; medical evacuation; and suppressive fire missions as an integral part of land force deployment operations. The UH-1H is organic to division, brigade and aviation elements worldwide.

## DEVELOPMENTAL BACKGROUND

The UH-1H is the fifth in the series of UH-1 "Iroquois" helicopters which are better known as "Hueys"--a nickname derived from their original designation, HU-1. The Army requirement for a utility helicopter capable of performing medical evacuation, instrument training and general utility missions was first outlined in December, 1952. General design specifications for the UH-1 were distributed to industry in May, 1954. Bell Helicopter Company (BHC) of Fort Worth, Texas, was selected to produce the aircraft in February, 1955. The UH-1A, which BHC produced until 1960, did not meet all military specifications. To correct the deficiencies, a more powerful engine and other improvements were included in a follow-on version, the UH-1B, which BHC produced between 1961 and 1965. The success of the "B" model and the requirement for a full squad carrier led to further development efforts. The UH-1D, produced by BHC between 1963 and 1967, is an enlarged fuselage version of the UH-1B, with increased seating capacity and fuel capacity. The UH-1D was redesignated UH-1H with the installation of a more powerful engine and a larger main rotor. BHC has produced the UH-1H since 1967.

## DESCRIPTION

The UH-1H (Iroquois) is a single main rotor and tail rotor, low silhouette, high performance, skid landing gear utility helicopter, capable of carrying a two-man crew and either eleven passengers or six litter patients. The aircraft is powered by a single gas turbine engine capable of 1400 Shaft Horsepower (SHP) flat rated to 1100 SHP for compatibility with standard UH-1 dynamic components. This allows use of the full 1100 SHP performance throughout a wide range of temperatures and altitudes. The aircraft features a fuselage constructed of monocoque aluminum alloy, and a two-bladed "teetering" main rotor assembly. Both rotors are constructed of "honeycomb" aluminum.

The aircraft is equiped with nose and side-of-fuselage hard points capable of accepting a variety of weapons systems, including two door pintle mounted 7.62mm or .50-cal. machine guns, a flare dispenser mounted in the cargo compartment, and a smoke generator subsystem.



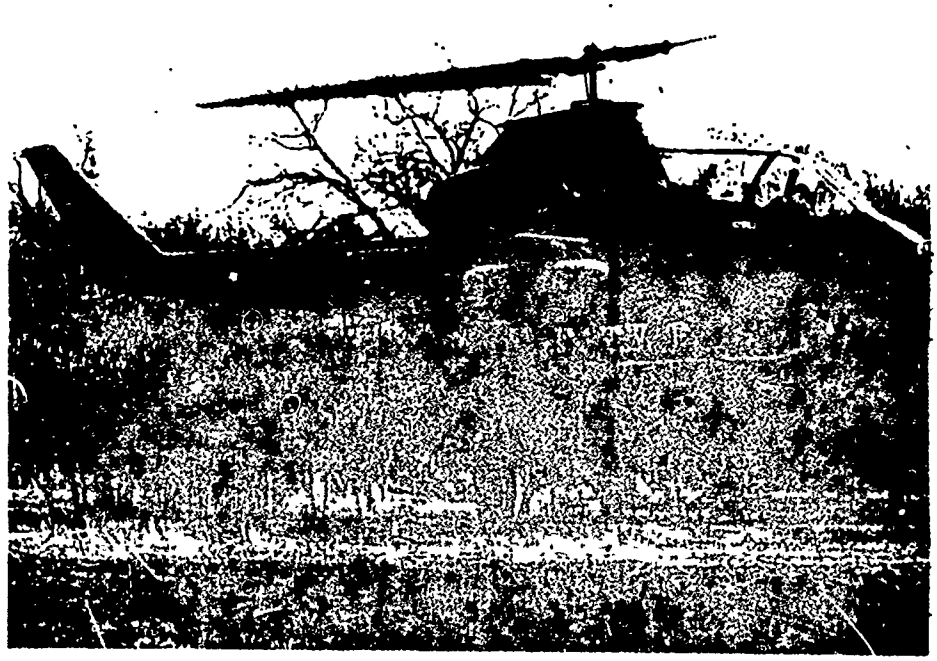
GPO 924.787

# U.S. ARMY FACT SHEET

**APRIL, 1970**

# AIRCRAFT

**NO. 6***



## AH-1G (HUEYCOBRA)

### CHARACTERISTICS

#### PHYSICAL

| | |
|---|---|
| Type | Attack |
| Length | 44 feet 5.2 inches |
| Height | 11 feet 7 inches |
| Main rotor diameter | 44 feet |
| Weight (empty) | 5560 pounds |
| (gross) | 9500 pounds |
| Fuel capacity | 270 gallons |
| Engine | Shaft turbine |
| Horsepower | 1400 |
| Armament | Varies with mission |

#### OPERATIONAL

| | |
|---|---|
| Maximum speed | 190 mph |
| Cruising speed | 144 mph |
| Range | 310 miles |
| Hover ceiling | 9500 feet |
| Service ceiling | 18,200 feet |
| Rate of climb | 1900 feet per minute |
| Payload | 3940 pounds |
| Crew | 2 men (one pilot and one copilot-gunner |

### EMPLOYMENT

The Army's first armed tactical helicopter designed specifically as a weapons platform, the AH-1G performs a variety of missions, including search and target acquisition, support fire for ground forces, escort and fire support for troop-carrying helicopters, and reconnaissance. The "HueyCobra" was first deployed to the Republic of Vietnam in early Fall 1967.

## DEVELOPMENT BACKGROUND

Development of the "HueyCobra" was begun in 1965 as a "house" project of the Bell Helicopter Company, Fort Worth, Texas. The AH-1G is the outcome of a long line of design development and refinement, based initially on the UH-1 series of "Hueys" also produced by Bell. Current production models of the "HueyCobra" combine the most powerful version of the original power plant with the very latest in available weaponry.

In April of 1966, the Army awarded Bell an initial production contract for AH-1G aircraft to fill an immediate need for an armed attack helicopter in the Republic of Vietnam. Since that time, additional contracts calling for several hundred more "HueyCobras" have also been awarded.

## DESCRIPTION

The AH-1G is a two-place, high speed, low silhouette, highly maneuverable and heavily armed attack helicopter. The "HueyCobra" is of all-metal construction and is powered by a shaft turbine engine with a military rated power of 1400 horsepower. This engine, however, is limited to 1100 effective horsepower by the power train.

Distinctive features of the aircraft include the very narrow fuselage (only 3 feet 6 inches wide at the cockpit); the small, tapered, swept mid-wings; the integral chin turret; and general aerodynamic cleanliness. Transparent plastic panels cover the upper portion of the crew compartment, providing maximum visibility for both the pilot and the gunner. An environmental control system is provided to heat and cool the cockpit. Improved handling and stability qualities are achieved by use of a three-axis stability and control augmentation system (SCAS).

Armament and ordnance are carried in the chin turret and on pylons under the two wings. Provisions are made for a number of interchangeable armament subsystems.

Normally the chin turret is equipped with one 7.62mm minigun and one 40mm grenade launcher. This turret can be reconfigured to accept either two miniguns or two grenade launchers.

A variety of weaponry can be carried on the wing pylons. A 7.62mm minigun pod may be mounted on either of the two inboard pylons. A 20mm cannon may be mounted on the left inboard pylon, while a 7-tube or a 19-tube aerial rocket pod may be mounted on any or all of the pylons.

*This Fact Sheet supersedes Aircraft Fact Sheet #6, dated January 1968, which is rescinded.

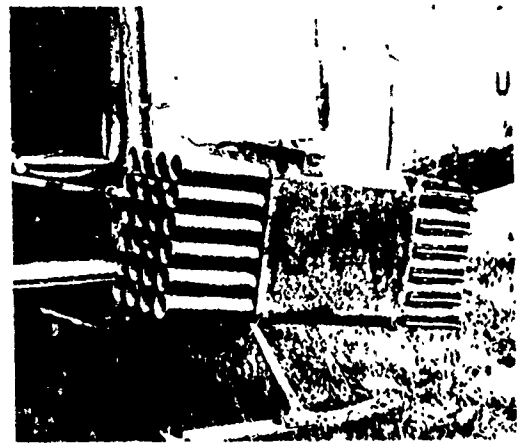
RECAPITULATION

UH-1 ARMAMENT SUBSYSTEMS[1]

[1]UH-1 Reference Data, Bell Helicopter Company (January 1966), II-4 to II-14. (Author's Note: These pages provide the reader with a survey of helicopter armament subsystems including a system description and specifications. Interested readers are referred to the following sources for a complete discussion of armament subsystems XM-1 thru GAV-2B/A. These include: .30 caliber, .50 caliber machineguns, 7.62mm machineguns, 20mm and 30mm automatic cannons, 2.75 inch FFAR, SS-10 and SS-11 wire-guided missiles, 40mm grenade launcher.) Charles O. Griminger, USA, LTC, "The Armed Helicopter Story Party," U.S. Army Aviation Digest, Vol 17, No. 11 (November 1971), 16-24. Charles O. Griminger, USA, LTC, "The Armed Helicopter Story Part VI," U.S. Army Aviation Digest, Vol 17, No. 12 (December 1971), 22-24.

## XM-3 ARMAMENT SUBSYSTEM

## 2.75" ROCKETS



DESCRIPTION - Two 2.75 inch FFAR (Folding Fin Aerial Rocket) launchers are mounted on external stores racks (one per side) at fuselage station 136 on the UH-1B and station 142 on the UH-1D. Each launcher has a 24-rocket capacity and can be manually adjusted in elevation from $0^{o}$ to $+6^{o}$ relative to the helicopter. Jettison of the launchers is accomplished by means of explosive attachment bolts.

SIGHTING SYSTEM - A Mark VIII sight is provided at the pilot's station; however, the system may be fired from either the pilot's or co-pilot's cyclic stick. Firing is always accomplished in pairs (one from each launcher) with the number of pairs being selected from a pedestal mounted intervalometer.

AMMUNITION - The 2.75 inch FFAR has been modified by scarfing or swedging the four nozzles to induce a clockwise spin about the longitudinal axis of the rocket, as viewed from the rear. The scarfed nozzles face the exhaust gases against the fins of the rocket, inducing a spin. The resulting spin of the rocket decreases the dispersion pattern.

PERFORMANCE - Flight tests of the original installation indicated no excessive vibrations. However, 15% decrease in Vne was required. Initial firing tests indicated nose down pitching when an excess of 18 rounds were fired at a rate of 24 rounds/second. Rate of 12 rounds/second resulted in good accuracy and firing characteristics with no adverse pitching.

WEIGHT - Installed kit weight is 482 pounds. Ammunition weight is 17.9 pounds per rocket. Complete system weight is 1267 pounds.

## M-5 ARMAMENT SUBSYSTEM

## 40 MM NOSE TURRET GUN

DESCRIPTION - A 40mm anti-personnel gun, contained in nose-mounted turret. Turret and support are mounted on three fuselage fittings in the forward nose section of the helicopter under the electronic compartment. Other primary components for this kit include a master control panel, sight, ammunition, ammunition boxes, booster motor, ammunition chuting and a servo amplifier box.

CONTROL - A pistol grip overhead sight, operated by the gunner and powered by 400 cycle A.C., controls the position of the turret which is driven by electric servo motors, through an azimuth 60° either side of the helicopter center line, an elevation of 13° and depression of 60°. The weapon can be fired by the gunner depressing the trigger on the pistol grip or by the pilot depressing a button on the cyclic stick. The weapon is aligned fore and aft with respect to the helicopter during pilot firing with elevation manually selected on the pedestal mounted control panel.

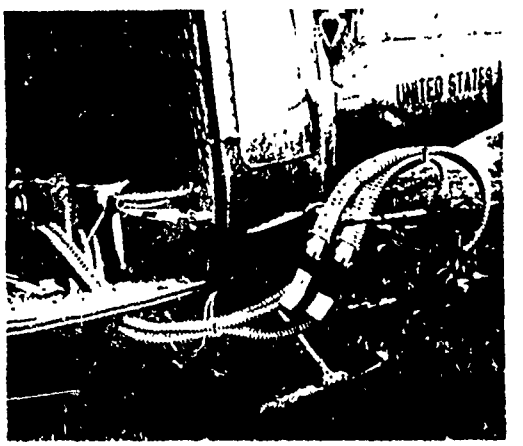
WEAPONS - M-75, 40mm Grenade launcher. Rate of fire: 220-240 spm Range: 700m., 3° elevation; 1200m., 7° elevation.

AMMUNITION - Ammunition is carried in boxes located in the aft cargo area. The ammo chuting is mounted on top of the deck and extends forward up the left side of the pedestal, through the electronic nose compartment and door to the weapon. A booster motor assists ammunition feed to the turret.

WEIGHT - Installed kit weight is 205 lbs. Ammunition weight is .75 pounds per round. Complete system with 150 rounds weighs 320 pounds.

## M-6 ARMAMENT SUBSYSTEM

## QUAD 7.62 MM MACHINE GUNS



DESCRIPTION - A pair of 7.62 mm M-60C machine guns installed on each side of the helicopter. Weapon azimuth and elevation controlled by turrets developed by the Emerson Electric Company.

CONTROL - A pistol grip sight located in front of the gunner on the left side of the helicopter is connected to D. C. power. Potentiometers in the system cause the hydraulically powered gun turrets to follow the motions of the sight. A control box for selection firing of the upper guns, lower guns, or all four guns, is located in the control panel console. Release of the "dead-man", switch on the sight pistol grip returns all guns to stow position (3° elevation from horizontal). Weapons may be fired in the stow position with either trigger and in any other position with the gunner's pistol grip trigger only.

TURRET TRAVERSE - The guns can be operated safely at an elevation totaling 75°: 9° elevation and 66° depression from a reference helicopter waterline. Laterally, a total of 82° can be obtained: 12° inboard and 70° outboard.

SIGHTING SYSTEM - The gunner's sight is a flexible lighted recticle with integral trigger. It is suspended from the cockpit roof above the gunner's head. The pilot's sight is a Mark VIII fixed lighted reticle which is stowed above the pilot's head when not in use.

AMMUNITION - Six thousand rounds of ammunition are carried in twelve boxes (3 boxes/weapon) under the aft passenger seat on the UH-1B. Ammunition containers are located forward of the troop seats at Station 93 on the UH-1D.

WEAPONS - Rate of fire - 550 shots per minute per gun. Maximum range - 3200 meters.

WEIGHT - Installed kit weight is 402 pounds. Ammunition weight 6.3 lbs/100 rounds. Complete system weight with 6000 rounds is 782 pounds.

## XM-14 ARMAMENT SUBSYSTEM

## .50 CAL MACHINE GUNS

DESCRIPTION - Two XM-14 gun pods (1 per side) are mounted on standard Kellet pylons which are attached to the External Stores Support. Each pod encloses an M3 Caliber .50 Automatic Machine Gun, 750 rounds of ammunition, an ammunition feed system with booster, and a pneumatic charging system. The pod is 16" in diameter and 118" long.

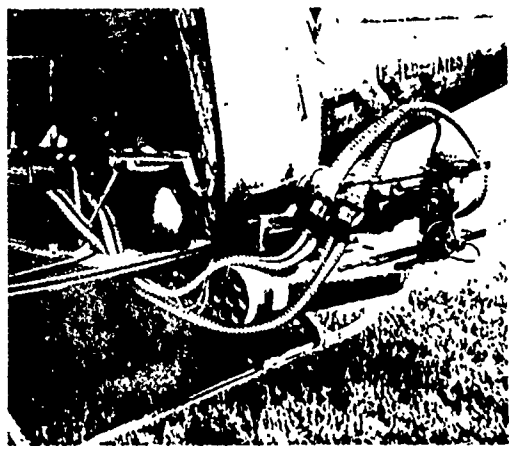
SIGHTING SYSTEM - A Mark VIII sight is provided at the pilot's station; however, the system may be fired from either the pilot's or the co-pilot's cyclic stick. Firing may be accomplished from either or both pods simultaneously.

AMMUNITION - 750 rounds caliber .50 contained in each pod. Firing rate is 1,200 spm.

WEIGHT - Installed kit weight is 592 pounds including 1500 rounds of ammunition. Ammunition weight is 225 pounds.

## XM-16 ARMAMENT SUBSYSTEM

## QUAD 7.62 MM MACHINE GUNS AND 2.75" ROCKETS



DESCRIPTION - Two LAU 32A/A (Aero 6D) rocket pods (one each side of aircraft) are mounted on bomb racks below the M-6 machine gun system. Each pod has a 7 rocket capacity. Electrical jettison of the rocket pods is provided. The system (except for rocket pods) is designed and built by Emerson Electric Company.

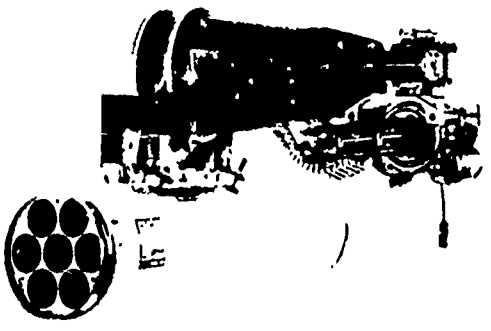
OPERATION - When the 2.75" FFAR are employed, the M-6 system operates in the stow mode. The elevation alignment of the M-60C machine guns is such that after the 7.62mm spotting rounds are deployed, minimum maneuvering of the aircraft is required to provide proper orientation for deployment of the FFAR rounds. An intervelometer for control of firing sequence is also provided.

SIGHTING SYSTEM - The gunner's sight is a flexible lighted reticle with integral trigger. It is suspended from the cockpit roof above the gunner's head. The pilot's sight is a Mark VIII fixed lighted reticle which is stowed above the pilot's head when not in use.

WEIGHT - Installed kit weight including external stores racks, M-6 system, bomb racks intervelometer, two LAU32A/A pods, 6000 rounds 7.62mm ammo, and 14-2.75" rockets is approximately 1210 pounds.

## XM-21 ARMAMENT SUBSYSTEM

## XM-134 "MINIGUNS" AND 2.75" ROCKETS



DESCRIPTION - The XM-21 is similar to the XM-16 system except that, rather than four M-60C machine guns, the XM-21 system uses two (one each side) XM-134 7.62 mm high cyclic rate machine guns. The same LAU 32A/A rocket pods (one each side of aircraft) are mounted on bomb racks below the XM-134 weapons.

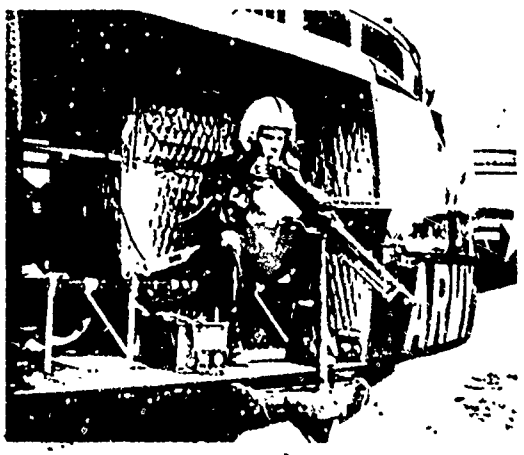
OPERATION - When the 2.75" FFAR are employed, the two XM-134 "Miniguns" operate in the stow mode. The XM-134 weapons fire simultaneously at 2000 spm each. The weapons are limited to 12° inboard travel; at that point the inboard facing weapon ceases firing and the outboard facing weapon automatically increases to 4000 spm.

SIGHTING SYSTEM - The gunner's sight is a flexible lighted reticle with integral trigger. It is suspended from the cockpit roof above the gunner's head. The pilot's sight is a Mark VIII fixed lighted reticle which is stowed above the pilot's head when not in use.

WEIGHT - Installed kit weight including external stores racks, XM-134 guns on M-6 system, bomb racks, intervelometer, two LAU32A/A pods, 6000 rounds 7.62 mm ammo, and 14-2.75" rockets is approximately 1216 pounds.

## M-23 ARMAMENT SUBSYSTEM

## MODIFIED 7.62 MM MACHINE GUN



DESCRIPTION - A single 7.62mm M-60C machine gun with modified trigger and sight can be installed on each side of the UH-1D. An adjustable mount is attached to the aft fuselage hard points.

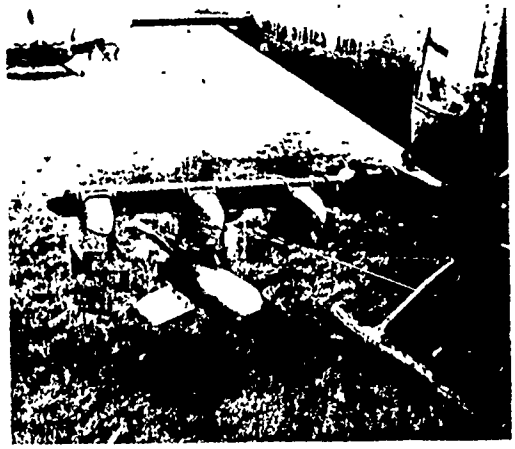
OPERATION - The M-23 system is manually fired and sighted by the crew chief/gunner.

AMMUNITION - Five hundred rounds of ammunition per box are manually loaded. Spent cartridges are collected in a self-contained catcher opposite the ejector.

WEAPONS - Rate of fire is 550 shots per minute. Maximum range is 3200 meters.

## M-22 ARMAMENT SUBSYSTEM

## WIRE-GUIDED SS-11 MISSILES



DESCRIPTION - Six (6) SS-11 wire guided missiles, three (3) on each side of the helicopter. Attached to launcher supports at fuselage Station 136.0 on the UH-1B and station 142.0 on the UH-1D.

SIGHTING - The gunner's sight is a 6-power, 12° angle of vision, binocular; the pilot's sight is a Mark VIII sight used to maintain ship heading on target.

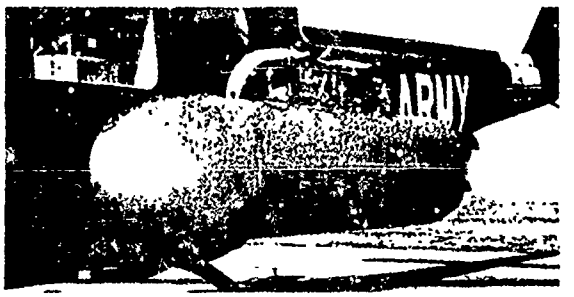
MASTER CONTROL - Missile selection and firing is accomplished through a master control panel (selector box) mounted in the cabin, convenient to the gunner. Missile guidance is accomplished by means of a side arm control. Missile launch operations are handled automatically by means of a sequencing fire control switch located on the command box (T-10K3). After completion of the missile flight the trailing wires are ejected from the missile launcher by depressing the wire jettison switch.

WEIGHT - Installed kit weight is 357 pounds. Missile weight is 63 pounds each. Complete system with six missiles weighs 759 pounds.

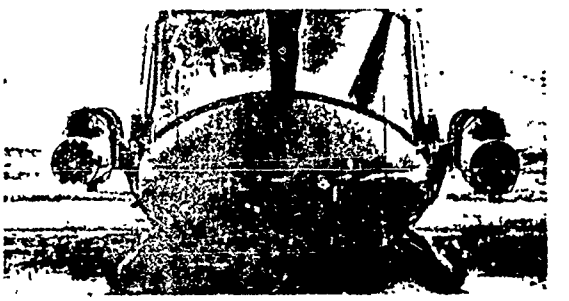
PERFORMANCE - Negligible effect on aircraft performance, stability and control. No ballast required as kit mounts on longitudinal C.G.

WEAPONS - The missile range is 3500 meters. Time of powered flight is 22 seconds. Armor penetrating capability (approximately) 23.5 inches.

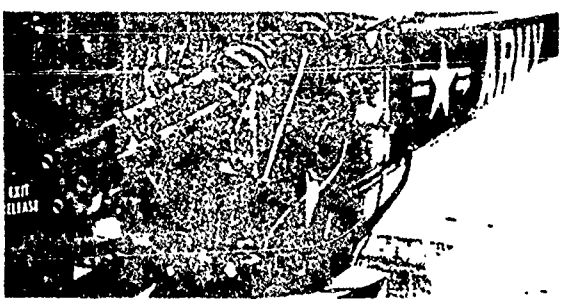
## OTHER UH-1 ARMAMENT SYSTEMS



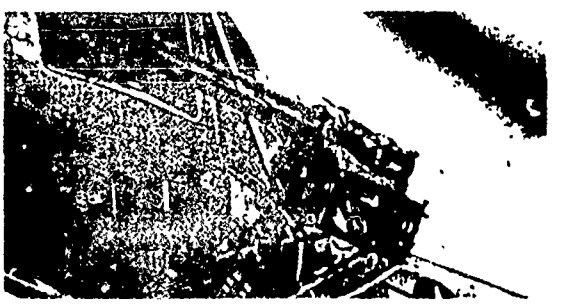

XM-3 Anti-personnel
mine dispenser



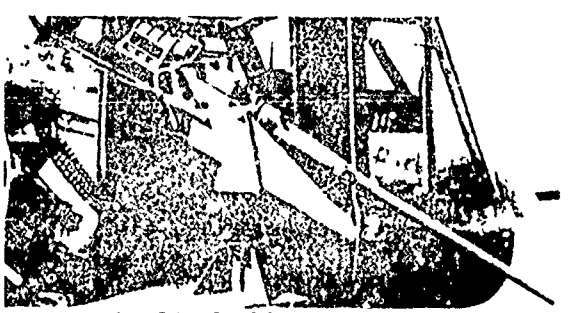
XM-17 LAU3A/A Rocket
pods (19 rockets/pod)



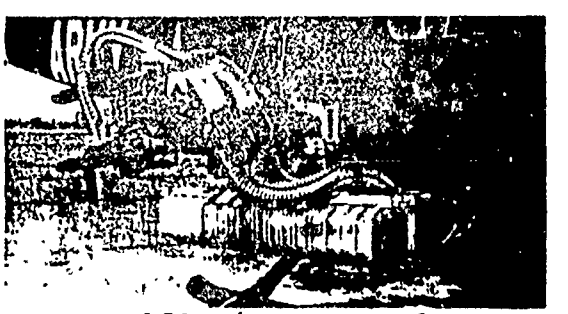
M-61 20mm Cannon
mounted in doorway



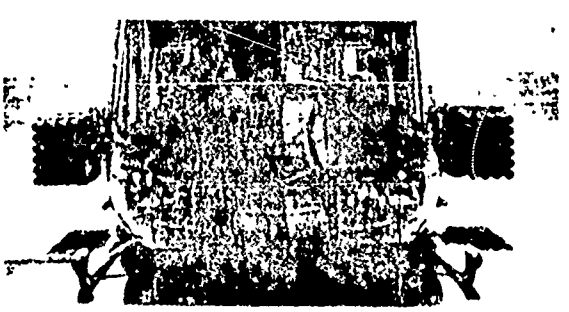
M-61 20mm Cannon
mounted on side



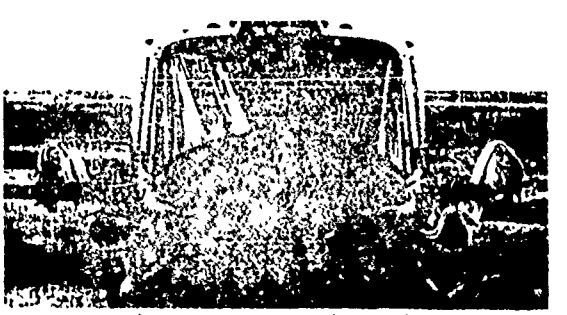
M-39A2 20mm Cannon
mounted in doorway



E-159 Riot control
CS cannister cluster



M-5/XM-3 combination



M-5/XM-16 combination

# AIRCRAFT SPECIFICATION SUMMARY

## Early Helicopter Characteristics

de Bothezat Helicopter[1]

weight 3585#

180 hp LeRhone, later replaced by a 220 hp engine capable of rotating the large blades at 90 rpm.

Four six-bladed rotors mounted at the outer ends of the four cross-booms or arms.

Platt-Le Page XR-1[2]

weight 4800#

450 hp Pratt & Whitney R985

Counterrotating tandem rotors mounted on boom-like pylons extending from the center of a conventional fuselage.

Sikorsky R-4[3]

weight 2500#

180 hp air-cooled

1 Pax + pilot although not capable of hovering w/full-load except under favorable conditions

three-bladed main rotor V and small antitorque tail rotor with a 14-foot radius.

---

[1]Gregory, p. 22. [2]Gregory, p. 94. [3]Shapiro, p. 92.

# RECAPITULATION OF ROTARY WING AIRCRAFT UP TO AAFSS[1]

| Designation | Manufacturer | Remarks |
|---|---|---|
| AAFSS | Lockheed | |
| AH-1G | Bell | |
| AH-56A | Lockheed | |
| CH-21 | Boeing | |
| CH-34 | Sikorsky | |
| CH-37 | Sikorsky | |
| CH-46 | Boeing | |
| CH-47 | Boeing | |
| CH-47 Composite Trainer | Boeing | |
| CH-47B | Boeing | |
| CH-54A | Sikorsky | |
| DH-2C Target Drone | Del Mar | |
| H-12 | Bell | |
| H-13 | Bell | |
| H-15 | Bell | |
| H-16 | Piasecki | |
| H-17 | Hughes | |
| H-18 | Sikorsky | |
| H-19 | Sikorsky | |
| H-20 | McDonnell | |
| H-21 | Boeing | Redesignated as the CH-21. |
| H-22 | Kaman | One Kaman K225 bought for Navy test. Powered by Lycoming O-435C 200 hp. |
| H-23D | Hiller | Redesignated. |
| H-23G | Hiller | |
| H-24 | Seibel | |
| H-25 | Piasecki | |
| H-26 | American | |
| H-27 | Piasecki | Designation for second YH-16 w/T-38 turbine engines. Later redesignated as the YH-16A. |
| H-28 | Hughes | Designation assigned to the improved H-17 Model M-190-4A. None ever built. |
| H-29 | McDonnell | Designation assigned to the 2-seat version of the H-20. The project was cancelled. |
| H-30 | McCulloch | |
| H-31 | Dorman | |
| H-32 | Hiller | |
| H-33 | Bell | Original Army designation given to the XV-3 Convertiplane. |

[1]Army Aviation Digest, XXIII, No. 8 (August 1969), 4-5.

| Designation | Manufacturer | Remarks |
|---|---|---|
| H-34 | Sikorsky | Redesignated as the CH-34. |
| H-35 | McDonnell | Original Army designation given to XV-1. Reserved for Navy use and then cancelled. Designation never utilized. |
| H-37 | Sikorsky | Redesignated as the CH-37. |
| H-38 | | Reserved for Navy use and then cancelled. Designation later assigned to a classified project. |
| H-39 | Sikorsky | |
| H-40 | Bell | The production models designated UH-1. |
| H-41 | Cessna | |
| H-42 | Hughes | Redesignated as the TH-55. |
| H-53 | Kaman | B model procured by the USAF for crash and rescue missions. Lycoming T-51-L-1 turbine engine. |
| H-46 | Boeing | |
| HO-1 | Sud | Full designation was YHO-1DJ. |
| HO-2 | Hughes | Full designation was YHO-2HU. Later became TH-55. |
| HO-3 | Brantley | Full designation was YHO-3BR. |
| HOK-1 | Kaman | |
| LOH | Hughes | Designated as OH-6A. |
| OH-4A | Bell | |
| OH-5A | Hiller | |
| OH-6A | Hughes | |
| OH-13A thru K | Bell | |
| OH-13S | Bell | |
| OH-13T | Bell | |
| OH23D, OH23G | Hiller | |
| OH-58A | Bell | |
| R-1 | Platt-Le Page | Twin rotor, side-by-side. P&W R-965 410 hp engine. Only two models were built. |
| R-2 | Kellett | The YG-1C Autogyro. Jacobs R-915-1 300 hp engine. Only one R-2 was procured. |
| R-3 | Kellett | Converted YG-1B Autogyro with feathering rotor. Jacobs R-755-3 225 hp engine. The R-2 and R-3 were the only true autogyros with official military designations. |

| Designation | Manufacturer | Remarks |
|---|---|---|
| R-4 | Sikorsky | First helicopter to be procured in quantity (131 bought). Warner R-550-3 200 hp engine. |
| R-5 | Sikorsky | The first XR-5 was a tandem rotor model, the VS-272; all others were single rotor. 132 procured in 11 models. Redesignated as the H-5. P&W R-985-AN-5 450 hp engine. |
| R-6 | Sikorsky, Nash-Kelvinator | 225 of the Sikorsky design produced by N-K as the R-6A and R-6B. Franklin O-405-9 240 hp engine. |
| R-7 | Sikorsky | A redesignation of the R-6A. Designation was later cancelled. |
| R-8 | Kellett | Twin rotors, side-by-side. Franklin O-405-9, 240 hp engine. Two procured. |
| R-9 | G&A Aircraft, Firestone | Only one procured. One two-bladed rotor. Lycoming O-290-7 135 hp engine. |
| R-10 | Kellett | Later redesignated as the H-10A. Crew of two; six litters. Two intermeshing rotors. Two P&W R-985-AN engines. Two procured. |
| R-11 | Rotor-Craft, Magill | Only one procured. Two contrarotating, three-bladed rotors. Continental A-100 100 hp. |
| R-12 | Bell | Later redesignated as the H-12. 5-passenger Model 48. P&W R-1340-55 600 hp engine. 13 procured. |
| R-14 | G&A Aircraft, Firestone | Three cancelled in 1946. |
| Scout | Bell | |
| TH-13 | Bell | |
| TH-55A | Hughes | |
| UH-1B | Bell | |
| UH-1C | Bell | |
| UH-1D | Bell | |
| UH-1D | Bell | 2 engine design. |
| UH-2 | Kaman | |
| UH-19 | Sikorsky | |

| Designation | Manufacturer | Remarks |
|---|---|---|
| VH-3A | Sikorsky | Twin turbine aircraft used by Presidential Flight Detachment during 1962-1966. |
| Whirlymite | Del Mar | Rotary-wing training device used during 1966. |
| Winged Helicopter | Bell | |
| XH-15 | Bell | |
| XH-51A | Lockheed | |
| XH-51A Compound | Lockheed | |
| YH-18A | Sikorsky | |
| YHC-1 | Boeing | |
| YUH-1B Compound | Bell | |
| 16H-1B Compound | Piasecki | |
| 16H-1C Compound | Piasecki | |

## Additional AAFSS Background Information[1]

Helicopters previously available in the Army inventory had been developed through evolutionary processes. The prime airframe contractors had followed basic patented principles, e.g., Bell Helicopter Company had produced a family of observation helicopters based on the proven OH-13 series and a family of utility aircraft following the design pattern of the H-40--UH-1 series. Boeing Vertol had produced a family of Tandem rotor, medium transport and crane path. All companies had followed aircraft engine growth by improving aerodynamic components to provide more life and speed exploiting improved and more powerful sources.

The requirement for a revolutionary approach generated a review of studies and experiments with winged helicopters, compound helicopters, tilt propellers, ducted fans and tilt-wing aircraft.

During the exploratory development phase in 1964, compound helicopters studied included concepts developed by Lockheed-California (rigid rotor plus auxiliary propeller), Sikorsky Aircraft (fully articulated rotor plus wing and auxiliary propulsion), Piasecki Aircraft (tail rotor-pusher propeller), Bell Helicopter (teetering rotor with wing and auxiliary propulsion) and Kaman Aircraft (servo-flap rotor with wing and auxiliary propulsion).

An Army Request for Proposal on 1 August 1964 resulted in responses from twelve airframe companies by 23 November 1964. The proposals were evaluated by a team of over three hundred Army, Navy, Air Force and National Aeronautics and Space Administration personnel between November 1964 and February 1965. The Planning Research Corporation, Los Angeles, provided cost effectiveness comparisons with the A-1, A-7, F4C, UH-1B armed helicopter and the OV-1D.

The several studies and resultant recommendations resulted in contract definition contracts with Sikorsky and Lockheed. Contract definition was completed by 1 September 1965. The Source Selection Evaluation Board and the Source Selection Advisory Council recommended deletion of some subsystems considered as not being reasonably attainable at the time or introduced excessive development risks. Recommended deletions included standard hot day performance (hovering out-of-ground effect at 6,000 feet a design gross-weight with a 95-degree temperature), advanced sensor devices, passive radar defense, laser rangefinders and terrain avoidance radar. The Lockheed system was recommended.[1]

---

[1] "Attack Helicopter The Key to Army Air Mobile Operations," A Report for the Blue Ribbon Defense Panel by Jay D. Vanderpool (COL, USA), Ret.

# SELECTED CHRONOLOGY[1]

| | |
|---|---|
| 1483 | Leonardo da Vinci sketched design using rotating, corkscrew fan to produce lift. |
| 1784 | Lannoy and Bienvenu demonstrated direct lift before French Academy of Science using counter-rotating blades driven by wound string and pulled by end of bent bow. |
| 1796 | Sir George Gayley improved Lannoy and Bienvenu model by placing blades at scientific angles. |
| 1843 | Sir George Gayley published design for twin rotor helicopter. |
| 1861 | Thaddeous S.C. Lowe's balloon ascent accomplishes the dual military missions of aerial observation and aerial artillery fire direction. |
| 25 September 1861 | Secretary of War Edwin M. Stanton orders creation of the Balloon Corps of the Army of the Potomac. |
| June 1862 | Balloon Corps made part of the Signal Corps. |
| June 1863 | Balloon Corps disbanded. |
| 1863 | Gustave de Ponton D'Amecourt built steampowered model helicopter with counter-rotating blades. Exhibited at Aeronautical Society of Great Britain exhibition at Crystal Palace in 1868. |
| 1870 | Alphonse Penand adapted Lannoy and Bienvenu design for rubber-band power, produced popular toy. |
| 1877 | Enrico Forlanini steam-powered design rose to 40 feet and remained aloft 20 seconds. |
| 1898 | Balloon Corps emerges to support Spanish-American War in Cuba. |
| 1907 | Paul Cornu used counter-rotating rotors, control vanes below, 24-hp Antoinette engine, two 20 foot rotors. On 13 Nov lifted inventor and two passengers, a weight of 723 lbs, to about 5 ft. and remained aloft one minute. |

[1]Author's Note: The information contained within this section was virtually consolidated from that already presented and documented. Other information was obtained primarily from two sources: Samuel C. Williams and COL Jay D. Vanderpool, both works previously referenced.

| | |
|---|---|
| 1907 | Louis Brequet with four main rotors, reached height of 4 ft. |
| August 1907 | BG James Allen establishes the Aeronautical Division of the Signal Corps. |
| 1910 | Igor Sikorsky in Kiev, Russia, produced helicopter which lifted itself from ground, powered by 25-hp Anzani engine. |
| 18 July 1914 | Congress formally creates an Aviation Section within the Signal Corps. |
| 1916 | LT Stefan Petrolozy and Professor Theodore von Karman with artillery observation helicopter, 3,200 lb gross weight, powered by three 120 hp engines, made 15 successful tethered flights; longest one hour duration. |
| 1917 | Engineering Division of the Air Service established by Act of Congress and War Department appropriation. |
| 6 April 1917 | U.S. enters World War I. |
| 1918 | Peter Cooper Hewitt helicopter design evaluated. |
| 21 May 1918 | President Woodrow Wilson creates two federal agencies: the Division of Military Aeronautics and the Bureau of Aircraft Production under the jurisdiction of the Secretary of War. |
| 24 May 1918 | Secretary of War Newton D. Baker combines new federal agencies into the Air Service. Aviation is no longer a part of the Signal Corps. |
| 27 August 1918 | Second Assistant Secretary of War becomes Director of Army Aviation. |
| 1919 | J.E. McWorter helicopter design evaluated. |
| 30 March 1919 | Igor I. Sikorsky arrives in New York City from Russia "almost penniless." |
| 1920 | Henry Berliner No. 1 used counterrotating, coaxial rotors, 80 hp engine, flew successfully. No. 2 used laterally-disposed counterrotating rotors, 80 hp engine. Berliner demonstrated direct lift in the latter machine in Washington, D.C., June 16, 1922. Machine now in Smithsonian Institution. |

| | |
|---|---|
| 1 June 1921 | Engineering Division contracts for construction of first helicopter from Dr. George de Bothezat. |
| 1922 | Henry Berliner seriously injured in helicopter accident. |
| 1922 | Dr. George de Bothezat in December demonstrated direct lift at Wright Field in official Air Service project. Weighed 3,600 lb., driven by 220 hp engine. Reached 6 ft. and stayed aloft two minutes. |
| 18 December 1922 | Initial flight of the de Bothezat helicopter. This historical flight gave the U.S. its first accomplishment in the helicopter field. |
| 1924 | Etienne Oemichen completed one kilometer closed course in machine weighing 4,400 lb., powered by 120 hp engine. This helicopter made more than 1,000 successful flights. |
| 1928 | Pescara successful flights in machine weighing 885 lbs. powered by 40 hp engine. |
| 1930 | D'Ascanio reached altitude of 59 ft and covered 3,500 ft in 8 min. 45 sec. Maitland Bleeker Curtiss-Wright-Bleeker machine made successful inside hangar at Valley Stream, Long Island, but depression caused termination of project. |
| 1931-1936 | Interim period of experimentation with Autogiro aircraft. |
| | von Baumhauer, Dutch inventor, used 200 hp engine, single main rotor, 80 hp engine driving tail anti-torque rotor. Machine damaged before its possibilities demonstrated. |
| 1935 | Oscar von Asboth, Hungarian designer, received British Air Ministry approval and Blackburn constructed partially-successful machine. |
| 1937 | Professor Heinrich Focke built first truly successful helicopter. The Foche-Angelis FW61 machine was flown from Bremen to Berlin by Hanna Rasche in June 1937. Rasche flew machine in Sportspalast in Berlin before German officials in 1938 and in 1939 Ewald Rohlfs set official records of 1 hr. 20 min. 49 sec. duration, altitude of 11,243 ft., distance of 143 miles and speed of 76 mph over a 20-km course. |

| | |
|---|---|
| 30 June 1938 | HR-8143 passed by Seventy-Fifth Congress authorizing $2,000,000 for research in rotary wing aircraft. |
| 1939 | Igor Sikorsky made his first flight in VS-300 helicopter 14 September 1939. On 15 April 1941 he remained aloft 1 hr. 5 min. 14½ sec. On 6 May 1941 Sikorsky established world helicopter endurance record of 1 hr. 32 min. 26 sec. |
| 31 May 1939 | Chief of Air Corps Conference establishes a preliminary required operational capability (ROC) equivalent:<br>useful load - 1500 pounds<br>crews - 2<br>fuel - 2½ hour capacity<br>airspeed - 0 (hovering) to 250 mph<br>minimum top speed of 120 mph<br>take-off and descent - at/from/to near vertical. |
| 19 July 1940 | Assistant Secretary of War approves contract no. 15375 with the Platt-Le Page Aircraft Company of Eddystone, Pennsylvania, for the second military helicopter. |
| 6 May 1941 | Sikorsky VS-300 helicopter remains aloft from 1 hr., 32 min., 26.1 sec. |
| 20 June 1941 | Congress creates the Army Air Forces. |
| 1942 | Design, installation and experimentation with a 20mm cannon in the nose of a Sikorsky R-5 begins. Experimental drop of practice bomb from helicopter. |
| 9 March 1942 | War Department establishes three co-equal commands: The Army Air Forces, the Army Ground Forces, and the Army Service Forces. |
| 6 May 1942 | Igor I. Sikorsky delivers the first US military helicopter to the Army Air Forces. Helicopter flown crosscountry from Sikorsky plant in Connecticut to testing facility at Dayton, Ohio. |
| 6 June 1942 | War Department approves aviation organic to Field Artillery. |
| 9 November 1942 | Army aircraft and pilots enter combat in North Africa (Fixed Wing). |
| 1 January 1943 | The US Army Aviation School is established. |

| | |
|---|---|
| 3 May 1943 | First helicopter evacuation of wounded. Accomplished in Sikorsky R-4 in Burma. |
| 1946 | Bell Aircraft Corp. was issued first Approved Type Certificate by Civil Aeronautics Administration on 12 March for Bell 47 model. |
| 1947 | Helicopter armament experiments halted due to reorganization of US military establishment. |
| 1947 | National Security Act of 1947 creates distinct military services. US Army authorized organic aviation. |
| 1947 | US Army purchased its first H-13 helicopters. The H-13, civilian designation: Bell Model 47; the first helicopter certified for commercial use by the US Government. |
| 1 September 1947 | First formal primary helicopter training commences at San Marcos, Texas. |
| 21 April 1948 | "Functions of the Department of Defense and Its Major Components" directive issued. |
| 1950 | US Army and Bell Helicopter experiment with a bazooka mounted on an OH-13 aircraft. |
| 25 June 1950 | North Korean Forces invade South Korea. |
| 29 August 1950 | USMC test fires 3.5" rocket launcher from helicopter. |
| November 1950 | First US Army helicopter, an OH-13B, flown into combat. First US Army helicopter "Mec-Evac" mission. |
| March 1951 | General Mark Clark expressed an interest in arming U.S. Army aircraft for specific missions. Project AC-951 initiated. |
| 21 September 1951 | USMC helicopter assault in Korea. |
| 1953 | 24th Inf Div experimented with makeshift grenade launcher in Japan. |
| 1954 | Project "ABLE BUSTER" at Fort Rucker. |
| 20 August 1954 | First acceptance of twin rotor aircraft by Army. |
| 13 October 1954 | Camp Rucker designated Fort Rucker and made a permanent Department of the Army installation. |

| | |
|---|---|
| 1 November 1954 | USAAVNS established at Fort Rucker, Alabama. |
| 1955 | Exercise "SAGEBRUSH" tests helicopters for reconnaissance and security. |
| June 1956 | BG Carl I. Hutton directs COL Jay D. Vanderpool to conduct experiments to determine the feasibility of arming the helicopter. Tests conducted principally at Fort Rucker, Alabama. |
| July 1956 | First Armament kit tested. |
| 13 July 1956 | GEN Wyman, CONARC Commander, formally approved armed helicopter experiments. |
| 1957 | Fort Benning, Georgia, unveils "World's Most Heavily Armed Helicopter." |
| 5 March 1957 | Formation of Sky Cavalry Platoon. |
| 6 June 1957 | Sky Cavalry Platoon officially unveiled before an industrial-military group symposium sponsored by the Association of the US Army. |
| November 1957 | Sky Cavalry Platoon redesignated Aerial Combat Reconnaissance Platoon Provisional, (ACR). |
| 25 March 1958 | Aerial Combat Reconnaissance Platoon Provisional redesignated 7292d Aerial Combat Reconnaissance Company (Experimental). |
| 1959 | Seventh Army Fire Suppression Kit tested in Germany. |
| May 1959 | USAAVNS completed study "Development Objectives for Army Aviation 1959-1970." |
| 1960 | Martin "Bullpup" radio controlled missile fired from CH-34. |
| January 1960 | Aerial Reconnaissance and Security Troop formed, patterned after ACR. |
| January-March 1960 | "Rogers" Board convened at Fort Eustis and later at Fort Monroe. |
| 16 May 1960 | First QMR for an armed helicopter weapons system approved. |
| 19 April 1962 | Famous McNamara memorandum calling Army Aviation Program "dangerously conservative." |

| | |
|---|---|
| June 1962 | General Hamilton H. Howze selected by Secretary of Defense McNamara to study application of the helicopter to situations on the battlefield. |
| 25 July 1962 | First armed helicopter company activated for Vietnam service on Okinawa. Designated the Utility Tactical Transport Company. |
| 9 October 1962 | First armed helicopter company arrives in Vietnam. |
| 7 January 1963 | Deputy Chief of Staff for Operations issued the initial plan for the organization, training and testing of an Air Assault Division and an Air Transport Brigade. |
| 15 February 1963 | The 11th Air Assault Division (T) activated at Fort Benning, Georgia, to test Howze Board concepts. |
| 27 March 1963 | Secretary of the Army Cyrus B. Vance announces beginning of the AAFSS Program. |
| June 1963 | First flight of Bell Sioux Scout, prototype of future armed helicopters. |
| February 1964 | General Earle G. Wheeler, Army Chief of Staff, makes "Big Jump" pronouncement. |
| March 1965 | Bell made decision to build a helicopter designed specifically to shoot as a company project. |
| Mar-September 1965 | AH-56A weapon system contract definition phase. |
| 26 April 1965 | First unit in Vietnam to receive the Distinguished Unit Citation, the 334th Aviation Company (Escort), the original UTT. |

AH-1G COBRA CHRONOLOGY

| | |
|---|---|
| July 1965 | Vietnam War requirement stated |
| March 1966 | Department of Defense approval |
| April 1966 | Letter Contract signed |
| September 1966 | First prototype delivered |
| January 1967 | Weapons test firing |
| March 1967 | First production delivery |

| | |
|---|---|
| January 1968 | Final flight certification |
| 3 November 1965 | Lockheed awarded contract to (ultimately) develop AAFSS and deliver ten (10) prototype aircraft for testing. |
| March 1966 | AH-56A Engineering Development Phase. |
| 3 May 1967 | Lockheed unveils first AH-56A prototype AAFSS. |
| 21 September 1967 | Cheyenne first flight. |
| 12 March 1969 | Prototype Cheyenne destroyed by "Half-P-Hop" phenomenon. |
| August 1970 | Review of AAFSS Program commences. |
| 22 September 1970 | Sikorsky introduces S-67 Blackhawk. |
| 28 September 1971 | Bell unveils King Cobra. |
| 1972 | US Army decides to conduct an effectiveness study to examine the Cheyenne and other candidate helicopters. |
| 1972 | MG Sidney M. Marks designated as Advanced Attack Helicopter Task Force Director. |
| 1 July 1972 | Competitive evaluations begin at Hunter Liggett Military Reservation between Cheyenne, Blackhawk and King Cobra. |
| 7 August 1972 | Marks' Task Force submits its evaluation of Cheyenne, Blackhawk and King Cobra to the Secretary of the Army. |
| 9 August 1972 | The Secretary of the Army officially terminates the Lockheed AH-56A program and simultaneously announces initiation of a program to develop an advanced attack helicopter. |
| 22 June 1973 | Secretary of the Army, Howard H. Callaway, revealed that Bell Helicopter and Hughes Helicopter were winners of a competitive evaluation designed to provide the US Army with an AAH in early 1980. |

SIGNIFICANT MILESTONES OF THE AAH PROGRAM

| | |
|---|---|
| June 1973 | Contract award. Mock-up review and critical design reviews were completed during third and fourth quarter FY 74. |

| | |
|---|---|
| June 1975 | Contractor ground test vehicle operation. |
| September 1975 | First initial flight. |
| June 1976 | Initiation of government competitive tests. |
| August 1976 | Source Selection Evaluation Board convenes. |
| September 1976 | Completion of government competitive tests. |
| November 1976 | DSARC II and Phase II contract award. |
| September 1978 | Completion of Phase II development contract. |
| August 1979 | DSARC III. |
| August 1981 | First production aircraft delivery. |
| 31 January 1975 | Bell YAH-63 ground test vehicle unveiled. |

# APPENDIX C

## ACRONYMS, ABBREVIATIONS, AND DEFINITION OF TERMS

### ACRONYMS AND ABBREVIATIONS

AAFSS: advanced aerial fire support system

AAH: advanced attack helicopter

ACCB: air cavalry combat brigade

ACR: aerial combat reconnaissance company

AH: attack helicopter

AHC: attack helicopter company

AMC: U.S. Army Materiel Command

ATGM: antitank guided missile

BAR: Browning Automatic rifle

BG: brigadier general

CACDA: Combined Arms Combat Developments Activity (Fort Leavenworth, Kansas)

CG: commanding general

CO: commanding officer

Co: company

COL: colonel

CPT: captain

DA: Department of the Army

Dia: diameter

DOD: Department of Defense

DSARC: Defense Systems Acquisition Review Council

FEBA: forward edge of the battle area

FFAR: folding fin aerial rocket

Ft: foot/feet

FY: fiscal year

Ga: Georgia

GEN: general

GTV: ground test vehicle

Hr: hour(s)

HQ: headquarters

In: inch(es)

Inf: infantry

IO: information officer

Kt: knot(s)

LTC: lieutenant colonel

Lb: pound(s)

LTG: lieutenant general

MAJ: major

MASSTER: Modern Army Selected System Test, Evaluation and Review (Fort Hood, Texas)

MAX: maximum

MG: machine gun

MG: major general

MM (or mm): millimeter; the size of an object

MPH: miles per hour

MSG: master sergeant

NK: North Korean

NOE: nap-of-the-earth flight

OACSFOR: Office of the Assistant Chief of Staff for Force Development

ODCSOPS: Office of the Deputy Chief of Staff for Operations

PAO: public affairs officer

PIO: public information officer

Prop: propeller

QMR: qualitative material requirement

RDTE: research, development, test and evaluation

Ret.: retired

SAM: surface-to-air missile

Sec: second(s)

SECDEF: Secretary of Defense

SHP: shaft horsepower

SP4: specialist four

SPM: shots per minute

STOL: short take off and landing

SY: school year

T: test

TECOM: test and evaluation command

TOW: tube launched, optically tracked, wire guided missile

U.S.: United States

USA: U.S. Army

USAARMS: U.S. Army Armor School (Fort Knox, Kentucky)

USAAVNS: U.S. Army Aviation School (Fort Rucker, Alabama)

USACGSC: U.S. Army Command and General Staff College (Fort Leavenworth, Kansas)

USAF: U.S. Air Force

USATMRB: U.S. Army Tactical Mobility Requirements Board (popularly referred to as the Howze Board)

USMC: U.S. Marine Corps

UTT: utility tactical transport helicopter company

Vt: Vermont

Wt: weight

U: Unclassified

VTOL: vertical take off and landing

X: (when preceding a weapon or aircraft designation) experimental

## DEFINITION OF TERMS

Army aviation mission: "The mission of Army aviation is to contribute to the capability of the Army to conduct prompt and sustained combat."[1]

Autogiro: "An aircraft whose forward propulsion is obtained by means of a conventional propeller driven by an engine, and designed with a horizontally mounted system of rotor blades on a shaft above the fuselage, such rotors being driven only by the air forces and intended to sustain the aircraft in the air."[2]

Helicopter: "A heavier-than-air carft (craft) which is lifted and held in the air by rotors or helicoid surfaces rotating on vertical axis and driven by power directly supplied to the lifting surfaces. An aircraft in which rigid wings are replaced by one or more rotating lifting surfaces called rotors. Its advantages are ability to have vertical ascent and descent and to hover without motion. Maximum forward speed is a secondary requirement."[3]

---

[1]Department of the Army, Army Aviation: General Provisions and Flight Regulations, AR 95-1 (18 October 1973), p. 1-4.

[2]Ernest J. Gentile (ed.), Aviation & Space Dictionary (Los Angeles: Aero Publishers, 1961), p. 48.

[3]Gentile, p. 181.

# BIBLIOGRAPHY

# BIBLIOGRAPHY

## Books


Butterworth, William E. Flying Army. New York: Doubleday & Co., 1971.

Deutsch, Andre. (ed). Insight on the Middle East War. London: Andre Deutsch Limited, 1974.

Francis, Devon. The Story of the Helicopter. New York: Coward-McCann, 1946.

Galvin, Lieutenant Colonel John R. Air Assault: The Development of Airmobile Warfare. New York: Hawthorne Books, 1969.

Gentile, E. J. (ed). Aviation & Space Dictionary. Los Angeles: Aero Publishers, Inc., 1961.

Gregory, Hollingsworth F. Anything a Horse Can Do. New York: Reynal and Hitchcock, 1944.

Hillway, Tyrus. Introduction to Research, 2d ed. Boston: Houghton Mifflin Co., 1964.

Marshall, S. L. A. Men Against Fire. New York: William Morrow & Co., 1947.

Montross, Lynn. Cavalry of the Sky. New York: Harper & Brothers, 1954.

_____. War Through the Ages, 3d ed. New York: Harper & Row, 1960.

Pretty, R. T., and D. H. R. Archer. (ed). Jane's Weapons Systems 1973-1974. New York: McGraw-Hill, 1974.

Rigg, Robert B. (COL, USA) How to Stay Alive in Vietnam. Harrisburg: Stackpole Co., 1966.

Ross, Frank X. Flying Windmills. New York: Lothrop, Lee & Shepard Co., 1953.

Schmidt, Dana Adams. Armageddon in the Middle East. New York: John Day Co., 1974.

Shapiro, Jacob. The Helicopter. New York: Macmillan Company, 1958.

Sherman, Arnold. When God Judged and Men Died. New York: Bantam Books, 1973.

Williams, Samuel C. Report on the Helicopter. New York: Edwards Brothers, 1956.

## Government Documents

James R. Schlesinger. Report of the Secretary of Defense James R. Schlesinger to the Congress on the FY 1975 Defense Budget and FY 1975-1979 Defense Program. Washington: Government Printing Office, March 1974.

Memorandum, Cyrus B. Vance, Secretary of the Army, Washington, D. C., Subject: High Speed Helicopter Weapons System, to the Chief of Staff, U.S. Army, Washington, D. C., 27 March 1963.

Department of the Army. FM 1-105, Army Aviation Techniques and Procedures. June 1969.

Department of the Army. FM1-100, Army Aviation Utilization. October 1971.

Department of the Army. FM 90-2, (DRAFT) Employment of Army Aviation in a High Threat Environment. Undated.

Department of the Army. AR 95-1, Army Aviation, General Provisions and Flight Regulations. 1 December 1973.

Department of the Army. U.S. Army Command and General Staff College, Profession of Arms Course 9000, quoting Major General Cushman.

Department of the Army. USAARMS, Command and Staff Department, "Historical Manuscript - Attack Helicopter Units," (undated).

Statement of General Creighton W. Abrams, Chief of Staff, U.S. Army, Before the Subcommittee on Defense, United States Senate, First Session, 93d Congress, 29 March 1973, p. 15.

U.S., Congressional Record, 93d Cong., 1st Sess. (1973) XVIII, No. 158, 519295-519426.

U.S. Congressional Record, 91st Cong., 2d Sess. (6 August 1970), Senator McIntyre, p. 512913.

Department of the Army. Training Circular 17-45-1 (DRAFT) Air Cavalry Combat Brigade. Undated.

Department of the Army. Training Circular 17-50-1 (DRAFT) Air Cavalry Combat Brigade. Undated.

Department of the Army. Vietnam Studies Air Mobility 1961-1971, LTG John J. Tolson, Washington, U.S. Government Printing Office, 1973.

National Security Act of 1947.

War Department, Bureau of Public Relations, Press Release. The United States Army Air Forces. 5 September 1941.

## Periodicals

Abrams, C. W. (GEN, USA). "Emphasis is on Readiness," Army, Vol 24, No. 10 (Oct, 1974), 8-9.

Barclay, C. N. (Brigadier, British Army, Retired). "Asian Combat Lessons - Do They Apply in Europe?" Military Review, Vol 1, No. 3 (March 1970), 11-19.

Barclay, C. N. (Brigadier, British Army, Retired). "Lessons from the October War," Army, XXIV, No. 3 (March 1974), 25-29.

Bailey, W. E. (CPT, USA), "Helicopter vs. Tank," U.S. Army Aviation Digest, Vol 13, No. 1 (Jan, 1967), 32-34.

"AH-56A CHEYENNE," Army Aviation, Vol 18, No. 8 (August 1969), 83.

"Bell Helicopter Company Premieres New Kingcobra," Public Relations Bell Helicopter Immediate Press Release, (September, 1971).

Barker, E. L. (LT, USN), "The Helicopter in Combat," US Naval Institute Proceedings, Vol 77, No. 11 (Nov, 1951) 1206-1222.

Beaufre, A. (General of the Army, French), "War in the Mideast," Infantry, Vol 64, No. 4 (Jul-Aug 1974), 12-16.

Bethouart, H. (MAJ, French Army). "Combat Helicopters in Algeria," Marine Corps Gazette, Vol 45, No. 1 (Jan, 1961), 36-41.

Blothirer, H. "Airmobility in Europe," Military Review, Vol XLVII, No. 3 (March, 1967) 87-91.

Boles, J. K., Jr. (COL, USA) and J. R. Degenhardt, (LTC, USA). "A Standard Emergency Task Force," Armor, Vol LXVIII, No. 6 (Nov-Dec, 1959), 39-41.

Bonanno, J. "The Helicopter in Combat," Ordnance, Vol XXXVIII, No. 203 (Mar-Apr, 1954), 868-872.

Britt, Randolph. "The Threat to United States Airmobile Operations," U.S. Army Aviation Digest, Vol 20, No. 9 (September, 1974), 1, 16-20.

Brower, Kenneth S. "The Yom Kippur War," Military Review, LIV, No. 3 (March 1974), 25-33.

Brown, B. A. (MAJ, USA), "Armed Helicopters," U.S. Army Aviation Digest, Vol XII, No. 10 (October 1966), 14-16.

Bu_ban, E. J. "Navy Using Armed Helicopters in Vietnam," Aviation Week & Space Technology, Vol 88, No. 21 (May 1968), 69-76.

Bunker, William B. (COL, USA), "Why the Army Needs Wings," Army, 6, No. 8 (March 1956), 19-24.

Christine, S. L. (CPT, USA), "First Combat Aerial TOW Team: Helicopter vs. Armor." Aviation Digest, Vol 20, No. 2 (February 1974), 2-5.

Clapp, Archie J. "Their Mission is Mobility," Military Review, Vol XXXIII, No. 5 (August 1953), 10-A.

Collings, L. K. (CPT, USA), "Possible-Feasible-Practical: Mid-Intensity Airmobility," Infantry, Vol 63, No. 6 (Nov-Dec 1973), 12-13.

Cruz, E. S. "The AH-56A 'Cheyenne' - U.S. Army's Newest Warrior," American Helicopter Society Newsletter, Vol 13, No. 8 (August 1967), 2-14.

Deane, J. R., Jr. (LTG, USA), "Army Aviation R&D Looks to Technology," U.S. Army Aviation Digest, Vol 20, No. 12 (Dec 1974), 2 & 3 - 20-23.

Delvey, F. X. (MAJ, USA), "Use All Fire Support Effectively," U.S. Army Aviation Digest, Vol 14, No. 1 (Nov 1968), 24-29.

"Deployment Trends - 1975," U.S. Army Aviation Digest, Vol 21, No. 4 (April 1975), 16.

de Transike, N. H. "The Genius of Dr. George De Bothezat," American Helicopter, Vol XXXXVII, No. 8 (July 1957), 6-14.

Dixon, R. J. (GEN, USAF), "The Range of Tactical Air Operations," Strategic Review, (1974).

Durrenberger, W. J. (COL, USA), "New Teeth for Copters in Vietnam," The Journal of the Armed Forces, Vol 102, No. 52 (Aug 28, 1965) 2-6-22.

Eley, D. L. (Wing Commander, RAF), "Role and Arming of Helicopters," Royal Air Forces Quarterly, Vol 7, No. 2 (Summer 1967), 100-101.

"A New Arm in Land Warfare?" Royal Air Force Quarterly, Vol 4, No. 1 (Jan 1952), 33-36.

"Black Hawk". Bee-Hive, (Fall 1970), 10-13.

Elwell, John and George Mathewson. "A Computer Model for the Evaluation of Helicopter Fire Control Systems," American Helicopter Society Journal, Vol 15, No. 3 (July 1970), 3-9.

Fairweather, R. S., Jr. (MAJ, USA). "Tomorrows Gunship: No Free Lancing," Army, Vol 73, No. 3 (March 1973) 12-19.

"Army Tests Heavily Armed Sky Cav 'copter: 42 Rockets, 9 Machine Guns, 2 Cannons." Army Navy Air Force Journal, Vol 95, No. 9 (Nov 2, 1957), 4.

Galvin, John R. (LTC, USA). "Develop Our Airmobility Now Before We Need It," Army, Vol 24, No. 7 (July 1974), 16-20.

Gavin, James M. (MG, USA). "Cavalry and I Don't Mean Horses," Combat Forces Journal, Vol XL, No. 11 (June 1954), 22-27.

Gentile, E. J. "Aviators Will Not Wear Spurs While Flying," The Journal of the Armed Forces, Vol 102, No. 50 (Aug 14, 1965) 22.

Glines, C. V. (LTC, USA), "De Bothezat's Flying Octopus." Airman, Vol VI, No. 1 (Jan 1962), 43-45.

"Soviets Deploy Mil Mi-24 Hind Gunship," Aviation Week and Space Technology, Vol 100, No. 9 (March 1974), 14-16.

"Huey Cobra." U.S. Army Aviation Digest, Vol XII, No. 5 (May 1966), 13-15.

"Army Aviation Milestones." U.S. Army Aviation Digest, Vol XII, No. 6 (June 1966), back cover.

Gratsolayev, V. "When Helicopters are Airborne," U.S. Army Aviation Digest, Vol 20, No. 9 (September 1974), 8-13.

Griminger, Charles O. (LTG, USA), "The Armed Helicopter Story," (Six Parts, July 1971 thru December 1971), U.S. Army Aviation Digest.

Grogan, O. R. (MAJ, USA), "Where Are Our Shooting Copters?", Infantry, Vol 50, No. 5 (Oct-Nov 1960), 32-34.

Hanby, J. B., Jr. (COL, USA). "Hellfire," U.S. Army Aviation Digest, Vol 21, No. 1 (Jan 1975), 24-27.

Horowitz, L. "2.75 inch Rocket Provides Tank Kills," U.S. Army Aviation Digest, Vol 19, No. 6 (June 1973), 14-15.

Hotz, Robert. "The Mideast Surprise," Aviation Week & Space Technology, Vol 99 (October 1973), 7.

Howze, Hamilton H. (GEN, USA, Ret.). "Airmobility Becomes More Than a Theory," Army, Vol 24 (March 1974), 19-24.

_____. "Speculations on the Future," U.S. Army Aviation Digest, Vol 20, No. 6 (June 1974), 6-7.

_____. "Helicopters in the Army," Ordnance, Vol XLII, No. 226 (Jan-Feb 1958) 634-638.

_____. "The Armed Helicopter in the Defence of Europe," NATO's Fifteen Nations, Vol 12, No. 4 (Aug-Sep 1967), 54-62.

_____. "Notes from the Pentagon on Meditation of Helicopter Vulnerability," U.S. Army Aviation Digest, Vol 3, No. 10 (Oct 1957), 2-4.

_____. "The Howze Board," Army, Vol 24, No. 2 (February 1974).

_____. "The Howze Board II," Army, Vol 24, No. 3 (March 1974).

_____. "Winding Up A Great Show Howze Board III," Army, Vol 24, No. 4 (April 1974).

_____. "A Key To Army Airmobility: The Advanced Attack Helicopter," Army Aviation, Vol 21, No. 12 (December 1972), 9.

_____. "Where We Are - Where We Are Going," U.S. Army Aviation Digest, Vol 20, No. 11 (November 1974), 1-4, 21-23.

_____. "Looking Into The Future," U.S. Army Aviation Digest, Vol 18, No. 3 (March 1972), 2-3.

_____. "Army Aviation Priorities," U.S. Army Aviation Digest, Vol 20, No. 12 (December 1974), 27-29.

_____. "'T' is for Transition," Army Aviation, Vol 23, No. 11-12 (Nov-Dec 1974), 9-12.

_____. "Reaching Translational Lift," Army Aviation, (July 1973), 1.

_____. "The Cheyenne Decision," Army Aviation, Vol 21, No. 9 (September 1972), 9.

_____. "Progress Report on Cheyenne Procurement," Army Aviation, Vol 20, No. 6 (June 1971), 4.

_____. "We're Reviewing All Proficiency Flying," Army Aviation, Vol 21, No. 1 (January 1972), 9.

_____. "We Face Mandatory Strength Reductions;" Army Aviation, Vol 21, No. 2 (February 1972), 11.

Muelander, B. A. (CPT, Canadian Army), "The Search for the Best Antitank Defense," Military Review, (Oct 1974), 61-68.

McInnish, H. J., Jr. "Germany Tests Airborne TOW", U.S. Army Aviation Digest, Vol 18, No. 3 (Mar 1972), 10-13.

"New Silhouette on the Horizon: The Bell KingCobra," U.S. Army Aviation, Vol 20, No. 11 (November 1971), 11-12.

Norman, Lloyd. "Debating The Future of Flying Tanks," Army, Vol 22, No. 2 (February 1972), 20.

Oswalt, J. W. (LTC, USA), "Report on the Rogers Board," U.S. Army Aviation Digest, Vol VII, No. 2 (February 1961), 15-17.

_____. "Shooting Helicopters Why & How Army Aviation Arms for Battle," Army, Vol 8, No. 10 (May 1958), 39-42.

Polmar, Norman. "Helicopter Warfare from the Sinai Desert to the Golan Heights," Air Force & Space Digest, Vol 50, No. 10 (October 1967).

Pouget, J. (MAJ, French Army), "The Armed Helicopter," Military Review, Vol XLIV, No. 3, (March 1964), 81-96.

Rawlings, M. G. "Must Another Indian Bite the Dust?", Army Aviation, Vol 19, No. 11 (November 1970), 8.

Redmond, D. G. (COL, USA), "The Role of Helicopters in Conventional Warfare," U.S. Army Aviation Digest, Vol 18, No. 1 (Jan 1972), 6-8, 35.

Rodwell, Robert R. "The Mideast War: A Damned Close-Run Thing," Air Force, Vol 57, No. 2 (February 1974), 36-41.

Ropelewski, R. R. "Army Completing AH-56A Tests," Aviation Week & Space Technology, Vol 96, No. 21 (May 1972), 55-59.

Seifert, A. E. (LTC, USA), "Fighting Helicopters?-Yes," Army, Vol LXVIII, No. 5 (Sep-Oct 1959), 58-59.

Seneff, George P., Jr. (LTG, USA), "11th Air Assault and the Future," U.S. Army Aviation Digest, Vol 20, No. 6 (June 1974), 24-30.

Shea, G. H. (LTC, USA), "From Horses to Helicopters," U.S. Army Aviation Digest, Vol 1, No. 4 (May 1955) 12-17 and 35.

"Sikorsky Unveils New Gunship," Army Aviation, Vol 19, No. 10 (October 1970), 38.

Starry, Donn A. (MG, USA), "Aviation - Part of the Armor Family," U.S. Army Aviation Digest, Vol 20, No. 6 (June 1974), 24-30.

Tarpey, Thomas M. (MG, USA), "Airmobility in Mid-Intensity Warfare," U.S. Army Aviation Digest, Vol 20, No. 7 (July 1974), 2-3, 29-31.

Terry, F. G. (CPT, USA), "The Armed Helicopter," Infantry, Vol 54, No. 4 (Jul-Aug 1967), 16-19.

Tolson, J. J., III (BG, USA), "Army Aviation Dates From Balloon Corps of 1861," Army Navy Air Force Journal & Register, Vol 100, No. 53, (Aug 31, 1963), 81 and 99.

Tooker, D. K. (LTC, USA), "Armed Helicopters," Marine Corps Gazette, Vol 50, No. 5 (May 1966), 45-47.

Tuck, W. R. (COL, USA), "The AH-56A in Support of Tank Operations," Armor, Vol LXXVII, No. 6 (Nov-Dec 1968), 3-10.

Vanderpool, Jay D. (COL, USA, Ret.), "We Armed the Helicopter," U.S. Army Aviation Digest, Vol 17, No. 6 (June 1971).

Vitti, David G. "The Navy's Armed Rescue Helicopter," American Helicopter Society Newsletter, Vol 15, No. 5 (May 1969), 4-8.

Weiler, J. "Gunships Key to a New Kind of War," The National Guardsman, Vol XXII, No. 10 (Oct 1968), 2-8.

"Cobra, Newest in the Huey Line," Rotor & Wing, Vol 1, No. 6 (Nov 1967), 22-28.

"Army Helicopters, How Did We Ever Fight a War Without Them," DATA, Vol 13, No. 8 (Aug 1968) 18-24.

"Israeli Paratroopers," Military Review, Vol LIII, No. 3, (March 73), 49-59.

"Sir Basil Liddell Hart's Disciples in Israel," Military Review, Vol LIV, No. 1 (Jan 1974), 13-23.

Wetmo, W. C. "German Army Seeking Armed Helicopters," Aviation Week & Space Technology, Vol 88, No. 15, (April 1968), 21-28.

Wyckoff, Theodore (MAJ, USA), "Mirror in the Sky," Army Journal, VI, No. 4 (November 1955), 30-31.

"Helicopter Exercises," Military Review, Vol LIII, No. 8 (August 1973), 95.

"Israeli Aircraft, Arab SAMS in Key Battle," Aviation Week & Space Technology, Vol 99 (October 1973), 14-17.

"U.S., Soviets Boosts Mideast Airlift", Aviation Week & Space Technology, Vol 99 (October 1973), 18-19.

"Soviet Aid Sparks Arab Gains," Aviation Week & Space Technology, Vol 99 (October 1973), 7.

"Sikorsky Copters Flown in Army Missile Demonstration," American Helicopter Society Newsletter, Vol 4, No. 8 (August 1958), 18, 20.

"UH-2," Army Aviation, Vol 18, No. 8 (August 1969), 81.

"YUH-1B", Army Aviation, Vol 18, No. 8 (August 1969), 82.

"XH-51A", Army Aviation, Vol 18, No. 8 (August 1969), 82.

"16H-1C", Army Aviation, Vol 18, No. 8 (August 1969), 71.

"YAH-63/GTV", Army Aviation, Vol 24, No. 2 (February 1975), 3.

"First Radio-Controlled Missile Fired From Sikorsky HUS-1," American Helicopter Society Newsletter, Vol 6, No. 7 (July 1960), 10.

Watson, J. D. (MAJ, USMC), "Marine Helicopters - Stunted Growth," U.S. Naval Institute Proceedings, Vol 99, No. 7 (July 1973), 34-41.

Zemek, Melville M. "First Cross-Country," Army Aviation, Vol 17, No. 5 (May 1968), 4-6.

Zink, G. K., Jr. (MAJ, USA), "The Vertical Flank," Infantry, (Nov-Dec 1974), 38-41.

"Navy Gunship Helicopters in the Mekong," U.S. Naval Institute Proceedings, Vol 84, No. 5 (May 1968), 91-104.

Technical Reports

Attack Helicopter - Daylight Offense, (USACDEC experiment 43.8), Vol II, Ground to air visual detection. AD No. 912802L, August 1973.

ACCB II Attack Helicopter Battalion Test Plan, AD No. 905932L, January 1972.

ACCB I Air Cavalry Attack Platoon Test Report, Vol I, AD No. 903566L, December 1971.

Attack Helicopter Squadron (ACCB II) Test Report, Executive Summary, AD No. 9001966, June 1972.

Attack Helicopter Squadron (ACCB II) Test Report, AD No. 900195L, June 1972.

Helicopter Exposure and Engagement Times When Firing a Laser Semiactive Fire and Target Missile, AD No. 894683L, April 1972.

The Aerial Vehicle: Technological Threat to Armored Warfare, AD No. 764663, February 1972.

SUD Aviation: Towards a New Generation of Rotary Wing Craft, AD No. 887371L.

Helos, Subs and Holography: A Report on Research and Development in France, AD No. 854946.

Army Aviators, AD No. 922675L.

International Helicopter Forum 9th, AD No. 9158701.

The Combat Tank of the Future, AD No. 909481L.

Boelkow BO 105 Multipurpose Helicopter, AD No. 9046381.

Do the Federal Defense Forces Still Need Tank Destroyers? AD No. 871035L.

Howze, Hamilton H. (GEN, USA, Ret.), "Cobra". Special Report on the World's First Attack Helicopter, American Helicopter Society, Reprinted from Verti-Flite, Vol 13, No. 9 (September 1967).

Mayhood, Thurlow T., and Benis, Henry G., General Electric Missile Production Section, "Helicopter Armament," reprinted from the October 1960 issue of American Helicopter Society Newsletter.

Theriault, P. W. "Status Report on Design Development of the AH-56A Cheyenne," 24th Annual National Forum Proceedings, American Helicopter Society, 1968.

Hogelin, George W. "AAFSS (AH-56A) Application of a Fully Integrated Avionics Aircraft Weapons System." 23d Annual National Forum Proceedings, American Helicopter Society, 1967.

Technical Papers on "Helicopter Armament." Presented at the American Helicopter Society's Fifth Annual New England Regional Clambake, 1961.

Walker, Robert J. "Night Observation and Weapon Fire Control System." 26th Annual National Forum Proceedings, American Helicopter Society, 1970.

Johnston, J. F. and J. R. Cook. "AH-56A Vehicle Development." 27th Annual National V/STOL Forum, American Helicopter Society, 1971.

Klivans, Larry S. "AVIARMFICS-Avionics - Armament - Fire Control System for the Cheyenne Weapon System," 25th Annual National Forum Proceedings, American Helicopter Society, 1969.

Oswalt, John W. "Armed Helicopters - A Forecast." 16th Annual National Forum Proceedings, American Helicopter Society, 1960.

Tactical Helicopter Employment Study, Prepared for U.S. Army Combined Arms Combat Developments Agency, BDM Services Co., 1973.

Vanderpool, Jay D. (COL, USA, Ret.), "Attack Helicopter The Key To Army Air Mobile Operations," A Report for the Blue Ribbon Defense Panel, (February 1970).

Johnston, J. F., and Cook, J. R., Rotary Wing Systems Engineering-Airframe, Lockheed, "AH-56A Vehicle Development," 27th Annual National V/STOL Forum, American Helicopter Society, Washington, D.C., May 1971.

Concept Paper, U.S. Army Aviation School, Concept of Employment of the Air Cavalry Combat Brigade in a High Air Defense Threat Environment (DRAFT), Undated.

UH-1 Reference Data, Bell Helicopter Company, (January 1966).

PAMPHLETS

Arms in the Persian Gulf. Washington: American Enterprise Institute for Public Policy Research, 1974.

The Arab-Israeli Military Balance Since October 1973. Washington: American Enterprise Institute for Public Policy Research, 1974.